

TWENTY-FIRST ANNUAL REPORT

OF THE

**A G R I C U L T U R A L E X P E R I M E N T
S T A T I O N**

OF THE

**K a n s a s S t a t e A g r i c u l t u r a l C o l l e g e ,
M A N H A T T A N .**

For the Fiscal Year 1907-'08,
Including an Index to Bulletins Nos. 148-155.

STATE PRINTING OFFICE,
TOPEKA, 1909.

ORGANIZATION OF THE
 Kansas State Agricultural College
Agricultural Experiment Station.

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EXPERIMENTING STAFF.

ERNEST R. NICHOLS, *President of the College*

- | | |
|----------------------------------|-----------------------------|
| CHARLES WM. BURKETT | Director |
| JULIUS T. WILLARD | Vice Director; Chemist |
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| ALBERT DICKENS | Horticulturist |
| ALBERT M. TENEYCK | Agronomist |
| FRANCIS S. SCHOENLEBER | Veterinarian |
| ROLAND J. KINZER | Animal Husbandman |
| THOMAS J. HEADLEE | Entomologist |
| WALTER E. KING | Bacteriologist |
| JOHN C. KENDALL | Dairy Husbandman |
| GEORGE A. DEAN | Assistant Entomologist |
| CLARENCE L. BARNES | Assistant Veterinarian |
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| GEORGE F. FREEMAN | Assistant Botanist |
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| LELAND E. CALL | Assistant Agronomist |
| EDWIN G. SCHAFER | Assistant Agronomist |
| CARL G. ELLING | Assistant Animal Husbandman |
| HERBERT F. BERGMAN | Assistant Botanist |
| ARTHUR L. PECK | Assistant Horticulturist |
| EARLE BRINTNALL | Assistant Dairy Husbandman |
| THEO. H. SCHEFFER | Assistant Zoologist |
| E. L. SIEBER | Assistant Chemist |
| J. B. PARKER | Assistant Entomologist |
| ETHEL W. EDWARDS | Executive Clerk |

FORT HAYS BRANCH STATION.

- | | |
|----------------------------------|---------------------------|
| CHALMERS K. McCLELLAND | Superintendent |
| ANDREW D. COLLIVER | Assistant in Agriculture |
| LESLIE E. HAZEN | Assistant in Horticulture |
| GEORGE K. HELDER | Secretary |

The regular bulletins of the Station are sent free to persons residing in the state who request them.
 Address, *Director of Experiment Station, Manhattan, Kan.*

KANSAS STATE AGRICULTURAL COLLEGE,
Manhattan, Kan., January 20, 1909.

To his Excellency W. R. Stubbs, Governor of Kansas:

DEAR SIR—I herewith transmit, as required by act of Congress approved March 2, 1887, the Twenty-first Annual Report of the Agricultural Experiment Station of the Kansas State Agricultural College, for the year ending June 30, 1908, including financial statements for that period. It does not contain full statements of the results of experimentation in the different departments and at the branch stations. These are printed in bulletins, paged consecutively throughout the year, and an index to those issued within the year is included with this report.

Respectfully,

E. R. NICHOLS,
President.

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Agricultural Experiment Station OF THE

Kansas State Agricultural College.

REPORT OF THE DIRECTOR.

To the Board of Regents of the Kansas State Agricultural College:

GENTLEMEN—I present herewith the following annual report of the Experiment Station work for the fiscal year ending June 30, 1908, for transmission to the governor of the state of Kansas as required by law:

The Experiment Station work has made substantial progress during the last twelve months and has been enlarged in a number of particulars, which are disclosed by the reports of the officers of the Station.

CHANGES IN THE STAFF.

Very few changes in the staff have occurred. Prof. Oscar Erf, dairy husbandman, was elected professor of dairying in Ohio State University and resigned his position here August 31, 1907. He was succeeded January 1, 1908, by Prof. J. C. Kendall, who at the time of his election was serving as state dairy commissioner. David M. Wilson, assistant dairy husbandman, resigned in January to take the office of state dairy commissioner and was succeeded by Earle Brintnall. Dr. C. L. Barnes has just resigned as assistant veterinarian.

A Department of Bacteriology has been created and Prof. Walter E. King, a graduate of Cornell University and recently employed in research work for Parke, Davis & Co., was elected as its head. This work had previously been done by the Veterinary Department.

The following additions to the force of assistants have been made: E. G. Schafer, assistant agronomist; C. G. Elling, assistant animal husbandman; A. L. Peck, assistant horticulturist; E. L. Sieber, assistant chemist, and J. B. Parker, assistant entomologist. At the Fort Hays Branch Station Jesse L. Pelham resigned as assistant in horticulture and was succeeded by

Leslie E. Hazen. J. A. Milham was made assistant in animal husbandry.

The resignation of the director was tendered to the Board of Regents last April and accepted, but does not take effect until September 1.

CHANGE IN THE ORGANIZATION.

After careful consideration and consultation with the director, the organization of the Station was modified somewhat, and the resolutions touching the matter are given here for convenience of reference. They are as follows :

Resolved, That in order to coordinate and strengthen the work of the Experiment Station of the Kansas State Agricultural College, the following regulations be adopted:

1. That the Experiment Station Council shall consist of the president of the College, the director of the Experiment Station, who shall be chairman of the Council, and the heads of the following departments: Agronomy, Botany, Entomology, Horticulture, Animal Husbandry, Dairy Husbandry, Chemistry, Veterinary Science, and, Bacteriology.

2. It shall be the duty of the Council to meet annually and discuss the possible lines of work to be carried out the ensuing year. It is intended that at this meeting a full and free discussion of proposed measures will be had, and that the work determined upon and the work under way shall be reported by the director to the Board of Regents previous to their January meeting, for its information and approval. Such a report to carefully set out: (a) the work being done; (b) the work proposed for the ensuing year, and (c) the immediate expenditure for the carrying on of old work and the expense of the proposed experiments.

It is recommended by the Board of Regents that the one or more major lines of work representing the typical interests of the state of Kansas, and in which all members of the staff, if possible, should cooperate, be selected. Other lines of work of an individual or restricted character may, of course, be outlined and prosecuted, but it is hoped that the work of this Station will have a special and definite direction along the line of the state's most dominant interests.

3. The regular meetings of the Council shall be held in February, April, June, August, October and December, and as much oftener as the interests of the Station may demand, and a meeting may be called at any time by the director.

4. The director shall prepare and submit to the Board of Regents, previous to its January meeting, plans for the Station work and estimates of expenditures for the following year. After the approval by the Board of such plans and expenditures, it shall be the duty of the director to see that such plans are duly carried out; and thereafter such work wherever carried on, shall be under his general supervision, or of such members of the Council as he may assign to it.

5. The director shall be responsible for the carrying out of the work of the Station, and it shall be his duty to see that all records are properly

kept and that the data relating to experiments be preserved and coordinated as fully as possible. He shall have full charge of the correspondence and the issuance of bulletins and all bills shall be approved by him before payment.

6. Members of the Council shall be individually responsible to the director as regards Station work, and shall be held to the performance of work or experiments approved by the Board of Regents.

7. All the work of the Station, wherever conducted, whether at Manhattan, Hays, McPherson, or elsewhere, shall be under the immediate charge of the director, and the director shall be held responsible for all work without regard to locality.

8. That any lands now held by the Kansas State Agricultural College, or the Experiment Station at Hays, that are not needed for scientific experimentation, may be leased only on condition that the lessees thereof shall keep and report to the director a complete record of the sowing, irrigation, cultivation, and yield of the crops grown on such land, and that this clause be made a part of any lease.

9. All heads of departments and other employees of the Station who have occasion to make purchases of machines, materials or equipments shall obtain competitive bids when competition is possible for such supplies, and no expenditure of this nature shall be made except with the approval of the director.

PUBLICATIONS.

The publications of the fiscal year have been as follows:

Twentieth Annual Report by the director, with which are incorporated reports of the heads of the various departments.

BULLETIN No. 148.—“Kansas Law Regulating the Sale of Commercial Fertilizers,” by C. W. Burkett and J. T. Willard. July, 1907.

BULLETIN No. 149.—“Prevention of Sorghum and Kafir-corn Smut,” by H. F. Roberts and Geo. F. Freeman. July, 1907.

BULLETIN No. 150.—“The Hen’s Place on the Farm,” by Oscar Erf. October, 1907.

BULLETIN No. 151.—“Alfalfa Breeding: Materials and Methods,” by H. F. Roberts and Geo. F. Freeman. December, 1907.

BULLETIN No. 152.—“The Pocket Gopher,” by Theo. H. Scheffer. February, 1908.

BULLETIN No. 153.—“Deterioration of Red Texas Oats in Kansas,” by H. F. Roberts and Geo. F. Freeman.

BULLETIN No. 154.—“The Mound-building Prairie Ant,” by T. J. Headlee and G. A. Dean. April, 1908.

BULLETIN No. 155.—“Alfalfa,” by C. W. Burkett, G. F. Freeman, A. M. TenEyck, H. F. Roberts, W. E. King, J. T. Willard, R. J. Kinzer, G. C. Wheeler, J. C. Kendall and T. J. Headlee. June, 1908.

PRESS BULLETIN No. 156.—Tables showing the result of the first six months of the egg-laying contest then in progress, by O. Erf. July, 1907.

PRESS BULLETIN No. 157.—“Alberta Seed Wheat,” by A. M. TenEyck. September, 1907.

PRESS BULLETIN No. 158.—“Destroying Pocket Gophers,” by Theo. H. Scheffer. December, 1907.

PRESS BULLETIN No. 159.—“Green bug,” by T. J. Headlee. February, 1908.

PRESS BULLETIN No. 160.—“A Great Need for Saving Soil Moisture this Spring,” by L. E. Call. April, 1908.

PRESS BULLETIN No. 161.—“The Chinch-bug,” by T. J. Headlee. June, 1908.

PRESS BULLETIN No. 162.—“Late Crops,” by A. M. TenEyck. June, 1908.

FEEDING-STUFFS AND FERTILIZER CONTROL.

At the session of 1907 the legislature passed an act concerning the sale of concentrated feeding-stuffs in this state, which is printed as chapter 407 of the Session Laws for 1907. This law went into effect July 1, 1907, and the director and the chemist of the Experiment Station are charged with special responsibility in connection with its administration. The registration of feeding-stuffs, with which are included condimental or medicinal stock foods, is in charge of the director, and this has brought an immense amount of work to his office. The analytical and inspection work in charge of the chemist is referred to in his report. The law was contested by the International Stock Food Company, but was sustained by the federal court. Some of its provisions were not looked upon with favor by the milling interests of the state, and at the special session of the legislature in 1908 the law was amended so that it no longer applies to pure bran, pure shorts, pure corn chop and various other feeds obtained by simply grinding a single grain. The original law sought to impose an inspection tax upon certain feeds when imported into the state of Kansas. The attorney-general advised that, as this seemed to interfere with interstate commerce, the provisions were probably unconstitutional and non-enforceable. Advantage was taken of the special session to cure this defect in the law.

The administration of the feeding-stuffs law and inspections conducted under it have shown that the need of such a law in

the state was very great. Many examples of adulteration and low-grade goods have come under observation. While there is still considerable misunderstanding and some disposition to evade the law, most manufacturers are complying cheerfully with its provisions and are in favor of the ends which it seeks to attain.

The fertilizer law which has been on the statute-books for a number of years was replaced by a new one by an act of the legislature at its session in 1907, the law being published as chapter 217 of the Session Laws for that year. The administration of the new law is in charge of the director and the chemist of the Experiment Station. The use of fertilizers in this state is not extensive as yet, but it is the desire of the Experiment Station authorities that the business develop along honorable lines, and that citizens of the state who have occasion to purchase fertilizers have a reasonable assurance that the goods they are buying are as represented.

EXPERIMENTS IN THE EXTERMINATION OF THE BINDWEED.

House bill No. 877, published as chapter 59 of the Kansas Session Laws for 1907, included a miscellaneous appropriation, No. 7: "To the State Agricultural College, to be expended under the direction of the Board of Regents, for experiments to exterminate the bindweed, for the fiscal year ending June 30, 1907, \$1000; provided, that any unexpended balance of 1907 is reappropriated for the fiscal year ending June 30, 1908."

The Board of Regents placed the execution of these experiments in charge of the director, and under his supervision two lines of effort have been followed and are still in progress. One of these is under the immediate direction of the agronomist, Professor TenEyck, who is trying various methods of controlling the bindweed by means of tillage, cultivation and the use of smothering crops. Professor Roberts, the botanist, is conducting an independent series of trials with various chemicals applied in solution by spraying the weed. The work has been in progress a sufficient length of time to disclose, if further evidence were necessary, the extreme difficulty of controlling this pest.

INVESTIGATIONS CONCERNING SEED WHEAT.

The legislature of 1907 passed an act designed to assist the wheat growers of the state in securing seed wheat from foreign

countries. It is printed as chapter 389 of the Session Laws of 1907. The text of the bill is as follows :

AN ACT authorizing the Board of Regents of the State Agricultural College to import seed wheat, as agents for the farmers of Kansas, and appropriating expense money therefor.

WHEREAS, The raising of wheat in the state of Kansas is one of the great sources of wealth and income to the state, and as it is of the very highest importance that the quality of the seed wheat of the state should be of the very highest; and

WHEREAS, It is conceded by those most competent to judge that the quality of the wheat and yield per acre deteriorates from year to year, until it becomes extremely desirable to obtain new seed from abroad, thereby tending to greatly increase the quality and yield of the grain; and

WHEREAS, The work and expense of properly investigating the quality of the imported seed wheat, the purity of the variety, its freedom from noxious seeds and vicious substances and desirability of introduction requires a large outlay of money and special knowledge, and the work should therefore be placed under authority of the state, which has the means and, in its Agricultural College, the qualified and trained experts to obtain the best results: therefore,

Be it enacted by the Legislature of the State of Kansas:

SECTION 1. That the Board of Regents of the State Agricultural College, located at Manhattan, Kan., shall thoroughly investigate the quality of seed wheat found in Europe or elsewhere, especially adapted to and desirable for sowing in Kansas, and if a satisfactory quality is found, they shall notify the board of county commissioners of the several counties in the state of Kansas when a satisfactory quality and quantity of such seed wheat can be purchased, and give the probable cost per bushel delivered at the county-seats of the several counties of the state.

SEC. 2. The board of county commissioners of the several counties which are interested shall give at least thirty days' notice in the official papers of their respective counties, setting forth that seed wheat can be imported under the supervision of the Board of Regents of the State Agricultural College, and will be for sale to applicants at the actual cost thereof, stating what such cost will probably be, and that all who are desirous of purchasing imported seed wheat shall make application for and may obtain for cash the quantity they desire, which shall not be in excess of twenty-five bushels for each head of a family or household.

SEC. 3. Every applicant for seed wheat shall be required to deposit with the county commissioners of his county the amount of cash required to pay for the wheat that he applies for, and to state in writing, on blanks furnished by the Board of Regents of the State Agricultural College, that he or she is a *bona fide* resident of the county of Kansas from which he applies for said seed wheat, and has been for the year past, and that he has the necessary ground on which to sow the said wheat and proper tools and teams for seeding and harvesting the same, and that he will properly sow the same and harvest the crop therefrom, together with such other information as may be required by the said Board of Regents

of the State Agricultural College, and will make such report on the said seed and its products as may be required.

SEC. 4. It shall be the duty of the board of county commissioners, or some one whom they may designate, of the several counties of the state to make requisition upon the Board of Regents of the Agricultural College for such amounts of seed as may have been ordered under this act, and to remit to the said Board of Regents the money therefor; and thereupon, on receipt of said requisition and money, the said seed shall be procured, and shipped as directed to the county commissioners for distribution.

SEC. 5. The board of county commissioners shall receive the sum of two dollars per day for the time actually employed in carrying out the provisions of this act; provided, such compensation shall not exceed in any one year the sum of twelve dollars for each commissioner; the same to be paid by their respective counties.

SEC. 6. For expenses necessarily incurred in properly executing the intents and purposes of this act, there is hereby appropriated, from the funds of the state not otherwise appropriated, the sum of twenty-five hundred dollars, or so much thereof as may be necessary, payable upon vouchers properly authenticated by the Board of Regents of the State Agricultural College.

SEC. 7. The state auditor is hereby directed to draw his warrants in favor of the Board of Regents of said Agricultural College upon the treasury of the state from time to time for the amounts of said vouchers. All requisitions by said Board of Regents for warrants hereunder shall be accompanied by a detailed statement of the expenses, verified by oath by the individual incurring such expenses.

SEC. 8. This act shall take effect and be in force from and after its publication in the official state paper.

Approved March 9, 1907.

Published in official state paper March 12, 1907.

Under the provisions of the preceding act the director of the Station was designated by the Board of Regents to make a trip to Turkey and Russia for the purpose of investigating the sources of seed-wheat supply and to make arrangements for importation if deemed advisable. He was employed on this mission about four months. Press Bulletin No. 164 gave an account of some of his observations, and was in part as follows:

The annual total yield of wheat in Russia averages approximately 625,000,000 bushels—just about the general average of the United States. In our country about three-fifths of the production is winter grown and two-fifths spring grown, while in Russia fully three-fourths of the wheat is spring grown. The spring-wheat yield in Russia is also increasing, due to the extension northward into new regions that do not admit of winter crops. As to the yield of these two classes, winter wheat gives the largest per acre, and averages from 25 to 40 per cent. more than spring wheat. It may be stated as an invariable rule that winter wheat gives a better yield than spring wheat; and in this connection it may be said, also, that the winter wheat in Russia requires and gets better care than spring

wheat. While the total production of wheat in Russia compares favorably with other countries, when compared as to yield per acre the comparison is far from favorable, as is seen from the following five-year-period averages: 1885-1890, 7.1 bushels; 1890-1895, 7.9 bushels; 1895-1900, 8.6 bushels; 1900-1905, 9.1 bushels. The 1906 average is estimated at less than 8 bushels per acre. If Russia's acre average equaled that of Germany, for instance, the annual production would not be far from 1,500,000,000 bushels. This low yield is not due to the type or the character of the soil, for the soil is relatively good, and many large areas are especially noted for their exceptional fertility.

The climatic conditions are unfavorable during certain years, giving rise to what are known as "famine years," that occur once or even twice during a five-year period. A leading cause of poor yield of wheat in Russia, of both winter and spring wheat, is the poor methods in vogue, especially the methods employed by the peasants and the uneducated land-owners. Agricultural methods in Russia are very primitive, including the rotation system, the methods of culture and the style of fertilization.

The common system of rotation in the center of the wheat belt is as follows: First year, fallow; second year, winter crop; and third year, spring crop. A not altogether uncommon system is that involving continued culture until the land is exhausted. It is given over to non-production, or resting, for ten, twenty or thirty years, or until its productivity is restored again. Leguminous crops as a part of the rotation system are, as a rule, never employed, and only on a few large estates. It is on these farms that the best farming is done in Russia, and real progress is now and has been for many years taking place.

Diversification of crops is therefore spreading and will become more popular in time. But it is unlikely that such will be at the expense of the wheat crop. Not only is the land abused in wheat growing, and the general rotation scheme unscientific and hurtful to the soil, but the tools and implements employed are of the most primitive sorts. In the first place, the kinds of farming tools are small in number, they are very poor, and altogether inadequate for doing the work required. The plow, so common and indispensable to us, is a luxury in many parts of Russia. In one district in Russia, less than 20 per cent. of the entire tilled land was broken with an iron plow. More than 75 per cent. of this work was done by a tool known as the *Sokha*, a forked-stick sort of plow, that scratches the soil from two, to four inches deep. A few wooden plows, between 5 and 10 per cent. of the total soil-breaking tools, are found in many of the wheat districts.

The reason so many poor tools in the wheat district are found is because of the poverty of the people. While primitive forms are employed by the peasants, on the other hand improved tools of all kinds, including plows, harrows, harvesters, and thrashers, are used on the large estates. Here some diversification in crops is practiced, fertilizers are often used, seed is usually selected, and improved methods are generally employed. On one estate near Kharkof more than 300,000 bushels of wheat were grown last year.

The quality of the red winter wheat of Russia is good, but perhaps no better than the present improved wheat stock of Kansas. Two sections

stand out prominently as sources of seed supply: Central Crimea (Taurida Province), especially between Simferopol and Melitopol; and farther to the north, in the Province of Kharkof, in its eastern part where the climate is very dry and cold. For purposes of comparison and tests at the Kansas Experiment Station and other places in Kansas, samples that have been under improvement have been secured from both of these districts. In all, about 20 varieties and lots were selected during the past summer, all of which are now at the Station and will be seeded this fall. These varieties will be tested in comparison with the improved varieties of the Station, and by another year the Station will have at hand real, positive information of the value of further importation, especially of large quantities for general state supply.

The wheat of Turkey is inferior to Kansas-bred wheat, and it is not advisable to look in that direction for improved seed stock.

The cost of importing the best selected seed wheat from Russia and delivering the same in Kansas will be approximately two dollars and fifty cents per bushel. This means good wheat, somewhat improved by selection, and fairly free from weed seeds.

The samples of wheat imported for trial will be tested at the Station here and as far as practicable at the Branch Stations at Hays, McPherson and Garden City. The following are brief descriptions of them:

No. 1169. Pererod (one peck). This seed is of selected quality and is from proprietors. It is common near Kharkof, Russia. A very hard wheat, not very uniform; quite a number of shrunken kernels and weed seeds; color, clear amber; weight per bushel, 57 pounds.

No. 1170. Russkaja (one peck). This is a common wheat and is receiving some attention by large estates in the way of selection at Liski, Povorina, Orel, etc. This wheat is quite hard, with a medium-sized kernel-perhaps a little small; color is a dark amber and medium in uniformity; contains but few weed seeds; weight, 58.5 pounds per bushel.

No. 1171. Pererod (one peck). This seed has been selected and is from proprietors. It is common near Kharkof; has a very hard, rather large kernel, light clear amber color and is quite uniform in size. It is a good grade of wheat but contains a few weed seeds. Weight, 59.75 pounds per bushel.

No. 1172. Russkaja (one peck). A common wheat, but it is receiving some attention in the way of selection by large estates at Liski, Povorina, etc. This is a medium-hard wheat with small berries of a rather dark amber color. It is not very uniform; contains a few weed seeds, is dusty, trashy and of poor grade. Weight, 52 pounds per bushel.

No. 1173. Pererod (one peck). This seed is from proprietors and has been selected. It is common near Kharkof; a medium-hard wheat, with medium to large berry, though small kernels are also noticeable; not uniform; light in color, yellow to amber; contains considerable trash and is a poor grade. Weight, 55.5 pounds per bushel.

No. 1174. Kritschewka (three pounds). Taken from a large farm near Chakow, where the seed has been rather well selected. This wheat is quite soft and contains some yellow berries. It is of medium size and of medium to poor grade.

No. 1175. Russkaja (one peck). This is a common wheat and is receiving some attention from large estates at Liski, Povorina, Orel, etc., in respect to selection. It is quite hard, has a medium to small kernel; dark amber color; of medium uniformity; contains some weed seeds and trash, but is a fair grade of wheat. Weight, 56.5 pounds per bushel.

No. 1176. Banatka (half bushel). Winter wheat from Kherson Experiment Station. This is a good hard wheat with a large kernel and dark amber in color. It is quite uniform in size and is free from weed seeds and trash. Weight, 59.25 pounds per bushel.

No. 1177. Ozucka (one peck). Red awnless winter wheat from Melitopol, 1906, Werkhne Dnyeprowsk Experiment Station, Yekaterinoslau government, Russia. This is a good hard wheat with medium-sized berry and of good amber color, but with a very slight tendency to yellow berry. It is quite uniform in size and free from weed seeds and trash. Weight, 57.5 pounds per bushel.

No. 1178. Byelotourka (eight pounds). Winter wheat from Kherson Experiment Station, Russia. This wheat is quite hard and has a large kernel but is not uniform, quite a number of small kernels being present; dark amber color; weight, 59.25 pounds per bushel.

No. 1179. Byelokolosska (one peck). From Kherson Experiment Station, Russia. This is a rather soft wheat, kernels of medium size and quite uniform; light amber in color; weight, 57.75 pounds per bushel.

No. 1180. (One bushel.) Egyptian (Egypetka) winter wheat from Stavropol Experiment Station. This wheat is quite hard, with a rather large-sized kernel; color, dark amber; uniform in size and color; a good grade of wheat. Weight, 59.5 pounds per bushel.

No. 1181. Byelokalinowka (one bushel). Winter wheat from Stavropol Experiment Station, Russia. A good hard wheat with a large kernel and dark amber color; quite uniform in size and color; weight, 56 pounds per bushel.

No. 1182. White awnless winter wheat from Werkhne Dnyeprowrk Experiment Station, Russia, government of Yekaternoslaw. (One bushel.) This is a rather soft wheat with a medium- to large-sized berry and dark amber color. It is uniform in size and color; clean and free from trash. Weight, 57.25 pounds per bushel.

No. 1183. Champanka (of Champagne) (one bushel). From Stavropol Experiment Station. A good hard wheat with large kernel, dark amber color and uniform in respect to size and color; of good grade, and free from trash. Weight, 59 pounds per bushel.

No. 1184. Redwish Auns (one bushel). From the Experiment Station of Don (Persianowka), government of Don. Medium to hard; medium dark amber in color; quite free from trash and of fair grade, though shrunken a little. Weight, 57.75 pounds per bushel.

No. 1208. Hard red winter wheat from south Russia (three bushels). Furnished by Mr. M. W. Rhode, care of British Consulate, Odessa, Russia, and imported through the United States Department of Agriculture. This is a dark, hard winter wheat, of good quality; contains a few weed seeds.

Prof. A. M. TenEyck made a personal investigation of the wheat grown in Alberta, Canada, in August, 1907, and studied the growing winter wheat in that province. Press Bulletin No. 157 gave the results of his investigation. Hard winter wheat has been grown there but six years, but the quality is equal to the best and large yields are secured. All of the hard winter wheat now grown in Alberta seems to have been derived from a car-load of so-called Turkey wheat imported from Kansas or Nebraska by Mr. E. E. Thompson, in 1902. Professor TenEyck says: "Although the Alberta Red is a wheat of excellent quality, yet there are some objections to it as seed wheat for Kansas. (1) It is originally nothing more than our ordinary Kansas wheat of the Turkey type, but not so pure as some of the improved varieties which we are growing to-day, such as the Turkey No. 4, Kharkof, and Malakoff. (2) Again, the Alberta Red has become mixed with a smooth-headed, soft winter wheat called the Odessa. This mixture with-soft wheat

does not usually affect the commercial grade of the wheat, but it injures its value for seed. I found no fields of Alberta Red wheat which did not contain some of this mixture of Odessa, the percentage of mixture varying from one to twenty-five per cent. This mixture has occurred from volunteer wheat, by sowing the Alberta Red in fields where Odessa wheat had been previously grown."

On account of the long distance and slow transportation it was found impracticable to import any large quantity of Alberta wheat for general seeding in Kansas in the fall of 1907. Samples were obtained, however, and a number are now growing in trial plots.

Prof. H. F. Roberts, botanist of this Station, left in May and will spend the season making investigations of wheat in Roumania, Hungary, Germany and Sweden.

COOPERATIVE WORK WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Coöperative experiments with the Department of Agriculture have been continued at the Fort Hays Branch Experiment Station, at the Branch Station at Garden City and at the Co-operative Station at McPherson. There has also been more or less informal coöperative work by the various departments of the Experiment Station. Reports of the work at Hays, Garden City and McPherson follow, with which is included some account of the coöperative investigations.

Within the succeeding pages are included reports furnished by the superintendents of the branch Stations and the heads of the several departments of the central Station at Manhattan, to which I ask your careful attention as a part of this report.

Respectfully submitted. CHARLES WILLIAM BURKETT.

REPORT OF THE FORT HAYS BRANCH EXPERIMENT STATION.

Prof. C. W. Burkett, Director: The legislature, at its session in the winter of 1906-'07, gave to the Branch Experiment Station at Fort Hays a more favorable patronage than it received from prior sessions, in that appropriations for maintenance and equipment were more liberal, which permitted the scope of the Station's work and purposes to enlarge during the year just closed. A more adequate fund for operating expenses

was allowed, as well as appropriations for needed equipment. These appropriations, augmented by funds received from sale of marketable surplus of crops grown and stock raised, were important factors in the success attending the work prosecuted at Hays throughout the fiscal year. More improvements of a permanent character were accomplished, so that the Hays Station shows, at the close of this period, a better establishment because of the improved financial condition and crop results.

The accompanying statement gives the year's finances in general:

Balance on hand June 30, 1907.....	\$1,249 55
Appropriations:	
Current expense	10,000 00
Roads and fences.....	2,000 00
Steam plowing outfit.....	3,500 00
Teams and equipment.....	2,000 00
Machinery	1,000 00
Pure-bred cattle	5,000 00
Building repairs	500 00
Superintendent's dwelling	3,000 00
Cottages	1,000 00
Horticulture and forestry.....	2,000 00
Dams and water system.....	2,000 00
Cash receipts:	
Cattle sold	2,826 89
Hogs sold	551 58
Horses sold (3 old).....	205 00
Wheat marketed	2013 69
Corn and Kafir-corn sold.....	536 20
Seed sold	912 78
From sundry sources.....	222 28
Total	<u>\$40,317 97</u>
By expenditures:	
Supervision and labor.....	\$9,829 07
Buildings and repairs.....	8,047 98
Fences	1,545 21
Roads and culverts.....	454 79
Horticulture and forestry.....	2,000 00
Horses and mules.....	1,572 50
High-grade cattle	4,202 05
Hogs	199 32
Steam plowing outfit.....	3,500 00
Farm machinery and tools.....	1,071 81
Harness and equipment.....	427 50
Steel reservoir	981 00
Water-system extensions	1,019 00
Miscellaneous merchandise	881 36
Seed	679 98
Feed	402 62
General Expense and repairs.....	835 37
Coal	328 60
Total	<u>\$37,978 46</u>
Balance June 30, 1908.....	<u>2,339 51</u>
Total	<u>\$40,317 97</u>

While the best economy was exercised in handling the Station's finances for the year, the above figures demonstrate that had it not been for the good crops of grain, from which revenue was obtained, and the sale of cattle and hogs, the rapidly growing work of the Station would have had to be curtailed owing to insufficient funds needed for its prosecution. It is patent to those familiar with the Fort Hays Station that our legislators should be importuned to make themselves personally better acquainted with this important and expanding institution, in order to provide intelligently for its needs.

LIVE STOCK.

According to a resolution of the Board, passed at its July meeting at Hays, all the cattle of the old herd were sold early in the year, except forty head which were held for a feeding test. The herd of forty was composed of ten head of calves, ten one-year-olds, ten two-year-olds, and ten head of old cows. Each bunch was fed in a separate lot on rations of corn and Kafir-corn meal in equal parts, with alfalfa and Kafir-corn stover. The experiment was begun November 14, and continued until February 7, at which time the entire lot was shipped to Kansas City markets. The old cows and the two-year-olds were well finished by that time; the yearlings were in fair condition, but the calves were not in shape to bring a good price as baby beef. It was desired to ship these along with the others, although it was quite evident that the feeding period for them should have been much longer.

Having about thirty-six head of hogs available for the purpose, a hog-feeding test was conducted at the same time as the cattle-feeding test, and hogs were marketed at the same time also. Each lot included Duroc-Jerseys, Poland-Chinas, and both crosses between the two, and were equal in weight and contained the same number from each sex. One lot was fed corn-meal, one lot Kafir-corn meal, and one lot mixed corn and Kafir-corn meal; and all lots were fed alfalfa. The test gave the relative value of corn-meal to Kafir-corn meal of 1: 1.12.

Some fifteen sows, old and young, were left over—a few of these farrowed in the fall and not all of them farrowed in the spring. However, a considerable number of shoats will be available for the coming winter's feeding test. All of the sows on hand are of the Duroc-Jersey breed, and the male was secured from the Chapin herd by purchase in January.

Preparatory to starting a new experiment—especial funds for which were provided by the legislature—new herds have been obtained during the year 1907-'08, consisting of twenty-five very high grade heifers of each of the breeds, Short-horn, Angus, Hereford, and Galloway, each herd headed by a pure-bred male of the very best breeding. These animals were secured by the aid of Professor Kinzer, of the College, at different times during the fall, winter and spring, and were all tuberculin-tested shortly after their arrival at the Station and found to be free of tuberculosis. They are all splendid individuals, fairly representative of their respective breeds.

One colt was foaled in July, one in April, and one in May of the current year. A driving- and a saddle-horse and three mules were purchased and three of the old horses sold. One horse died. It was found necessary to hire teams from the middle of June on.

AGRONOMY.

Wheat.—The wheat crop of 1907 was only a fair one, as stated in the previous report. It was thrashed in August and the results gave some good lessons on time of plowing, methods of preparing soil and time of planting. The several experiments were carried on again for the present year, but on account of better climatic conditions the results promise much better. There were several heavy falls of snow during the winter months and occasionally light showers. A drought prevailed from the middle of February to the middle of April and considerable wind blew, but April 20-21 gave a precipitation of two inches that started the wheat nicely, and frequent rains occurred up to the middle of June, so that the winter wheat promises to be extra good. Harvest began June 26 and is now progressing.

Spring Grains. —Oats, barley and emmer reported planted in the spring of 1907 were failures on account of the very unfavorable spring weather. Because of this, the Station was compelled to obtain a new supply of such seeds, which it did from the Manhattan Station mostly, but in some instances from dealers and farmers. The spring conditions of 1908 were much more favorable, and these crops will make fair, though not heavy, yields.

Corn. —The crop of 1907 was excellent and demonstrated that corn-growing is practicable in this section of Kansas. The

summer rainfall amounted to fifteen inches, which, with careful tillage, ought to produce a good crop on any well-prepared land. A measured area of forty-four acres gave a yield of 41½ bushels per acre, on bottom-land.

In 1908 about seventy-five acres of bottom-land were put in corn, and some ninety acres of upland, which had been in wheat in 1907, having been plowed in July, was put in corn also. Because of the continued rains in early June, the present crop is very promising.

Kafir-corn. —The 1907 crop was good. The work of heading and thrashing a large acreage was carried on well into the winter, and a total of 2800 bushels was thrashed, some of which was used in the feeding experiments, and nearly 900 bushels still remain in the elevator.

A smaller acreage was planted in 1908, and because of the heavy rains as it was coming up, about sixty per cent. of it had to be replanted, thus considerably increasing the amount of work for the Station force and promising a belated crop in the fall.

Milo Maize. —Some fifty acres were planted, a large part of which fared as did the Kafir-corn and had to be replanted. However, both these crops are now coming on nicely and will make a good supply of forage for next winter's feeding.

Alfalfa.—This is a very important crop upon the Station and makes three good cuttings, and in the fall of 1907 a fourth cutting was obtained over perhaps two-thirds of the alfalfa acreage. The second, part of the third, and the fourth cuttings were baled, and a considerable part of this is still in barn.

The new seeding of alfalfa upon field 9-1 was not entirely successful. Perhaps 18 acres, out of the 100 acres seeded, were found to have a good stand. The dry spring, with heavy growth of foxtail later, are responsible for this failure. The entire area was again seeded under good conditions in the spring of 1908, but again with not entire success. In addition to this, the entire area, 90 to 100 acres, on field 4-4, was seeded to alfalfa under the best of conditions and a good stand was obtained over probably 95 per cent. of the entire field. This will insure a plentiful supply of alfalfa for the feeding experiment soon to be inaugurated.

COOPERATIVE WORK.

Coöperative work has been continued by the Fort Hays Branch, in connection with the Bureau of Plant Industry, United States Department of Agriculture, both in dry-land farming and cereal investigations. The Office of Dry Land Farming put in this year several new instruments in order to obtain more complete data on climatic and other conditions. In addition to the "triangular" experiments with winter and spring wheats, a new series was started along the same lines with Kafir-corn, milo maize and Kowliang—all non-saccharine sorghums.

IRRIGATION WORK.

In 1907 only the alfalfa plots were irrigated (in June). In July a precipitation of nine inches did away temporarily with the necessity for irrigation and no more was done. High water from Big creek overflowed most of the unirrigated plots, and influenced any results which might have been obtained from irrigation of previous years.

In February and March of 1908 the plots were well watered and steps taken to conserve that moisture for the 1908 crops, and in addition to alfalfa, the usual crops of beets, corn and potatoes were put in.

VARIETY WORK.

In last year's report an account was given of the variety testing done at Hays. There were no results obtained on any of the grains except corn during the present year. As mentioned before, the spring small grains were failures in this county; and after the wheat was in the shock a flood swept over the field, washing away some of the shocks entirely and so badly mixing up the bundles that no reliable data could be secured.

Twenty varieties of corn were tested, with results varying from 14.2 to 77.7 bushels per acre. In the fall of 1907, some forty varieties of winter grains were planted, and in the following spring four varieties of oats, four of barley, and two of spring wheat were seeded in test plots.

In seed improvement and distribution, the Station is trying to determine what varieties of the various grains are best suited to western Kansas conditions; then to increase the supply of pure seed of the particular varieties with a view of supplying them to those who may wish to be benefited by the

experiments. Aside from variety tests of corn and Kafir-corn, ear-to-row and head-to-row plantings have been made of a few of the better varieties and selections from these used as a basis in seed improvement. Selected seed-corn to the extent of 185 bushels was sold in the spring of 1908 from the varieties Minnesota No. 13 and Pride of Saline (Kellogg's). Several bushels of both the red and the white Kafir-corn were sent out also. In the fall of 1907, 290 bushels of Kharkof seed wheat were shipped to various parts of the state, all of which shows that the farmers want better varieties, and the Station can do much good if it can supply this increasing demand for pure and improved seeds. The work, from what little the Fort Hays Station has done, has shown the need of better facilities for storing, cleaning and handling such seeds; and it is to be hoped that appropriations will be forthcoming to supply this want.

FIELD EXPERIMENTS.

Field experiments have been of various kinds and with all the above-mentioned crops. The seed-bed tests, time-of-plowing, rotation, manuring, and time-of-seeding tests with wheat were continued. Two new lines of experimentation were started; one to determine the effect of spring preparation (plowing, listing, or disking in February) on corn which was partly listed, partly surface-planted, in May; another to determine the effects of use of the disk or alfalfa harrow upon alfalfa when treated in fall, winter or spring; or after the first, second, third or all cuttings.

The field experiments, being conducted on extensive acreage, require more equipment than is available at present, and the passing season the Station is hiring both teams and machinery to prosecute the work.

HORTICULTURE AND FORESTRY.

Of the trees planted in 1907, mentioned in a former report, a very small percentage grew. The dry spring of that year, with no rains until June, proved their ruin. Upon block "A," of the upland plantation, none of the fruit-trees were saved and a very few of the forestry planting. As a result of this, the tree-planting work of 1908 was considerably above the normal and necessitated a large force of men for several weeks. The work was done as carefully as possible, the holes being dug and the ground thoroughly soaked; tree roots were puddled, and after the hole was partly filled about the tree more water

was given and the hole filled up with loose, dry soil as a mulch. One team was employed practically all the time for several weeks, hauling water for this work, and after the planting was completed all the trees so far as possible were again watered to insure their starting.

Failure in this year's planting may be attributed to three reasons: Many of the trees were carelessly packed in nursery, so were quite dry when unpacked at the Station; some were carelessly planted; and some were never watered after being set out. The spring planting, with percentage of loss, is as follows:

	Set.	Loss.
Osage	6,500	6.2 per cent.
Catalpa	12,000	2.5 per cent.
Honey locust	1,000	2.7 per cent.
Black locust	1,000	100.0 per cent.

Several hundred each of Black locust, Russian mulberry, ash, elm, pine, hackberry, Kentucky coffey, poplar, cedar and soft maple were planted and the loss was small.

Apple	425	20 per cent.
Plum	249	60 per cent.
Pear	171	12 per cent.
Cherry	430	15 per cent.

In addition to these there were several hundred peach and a number of apricot and cherry trees set out as fillers in orchard plantings; also a number of bush fruits—blackberries, raspberries, gooseberries and currants.

Most of the fruit- and forest-trees were put into the upland field plantation started last year, mentioned in a preceding report, but replantings were made in all of the old orchard and forest plots set in former seasons, some plots being enlarged by new catalpas. Then tree planting was begun about the distant buildings of the Station—the old fort properties and cottage on section 10. Taken all in all, the season was a fair one for tree work and the results were quite satisfactory in the main.

Vegetable work begun in 1905 is still continued, comprising tests of varieties of table vegetables in cultivated and straw-mulched gardens, under irrigation *versus* no irrigation, and some comparison of home-matured seed with that of seed from other growers on the market.

IMPROVEMENTS.

The improvements upon the Station grounds during the year 1907-'08 have been considerable. Three and one-half miles of public road were graded and kept dragged with the King drag, and a half-mile upon the farm proper. A mile of good woven-wire fence was built on the north line of the state park, extending eastward along the public road by section 4. The half-section of unused land on section 16 was fenced and a well driven so that the field could be used as pasture. Still more fencing was constructed, enclosing sixteen acres of alfalfa on field 10-3, thus enabling us to handle more hogs.

A new cottage was built on section 10, some distance from the main buildings, and occupied by a workman and his family. Adjacent to this cottage a small barn, wood-shed and water-reservoir were located and a well driven to supply water, by pipes, for the house, barn and storage tank. This plant has proven a great convenience in many respects. Men working in the vicinity with teams carry their dinners and feed teams at this barn, thus saving over two miles of travel whenever this happens. The storage tank lessens the haul of water to steam plow or thrasher by a mile and a quarter.

The new steel reservoir erected upon the stone tower at the main plant has a capacity of 20,000 gallons, which gives a storage capacity that will be adequate for a long time. At the central plant a superintendent's house and a new machinery-shed were erected. The former is an elegant, commodious house with seven rooms, furnace and bath, and is located north of the cottage formerly occupied by the superintendent. The machine-shed has space for the steam plow on one side and a small engine and separator on the other; between these there is a blacksmith shop and implement room, and a floor above gives general storage for repairs and equipment.

The Station purchased and received in July, 1907, a Reeves thirty-two-horsepower steam plowing outfit and was thereby enabled to prepare the wheat ground better than would otherwise have been possible. Over 400 acres were plowed in the fall with this outfit, and it was started for the 1908 work about June 20, which work is progressing nicely at this date. A new twelve-foot header was purchased in July, and two crews worked at times during the harvest season. In the spring of 1908 a hay-stacker became necessary because of the large

amount of alfalfa to be put up, and with this we hope to save our crop in better shape than in 1907. However, because of continued rains the first half of June, about half of the first crop was lost and the balance left ten days longer than it should have been.

LABOR AND SUPERVISION.

There has been improvement in the labor situation to a marked degree. One family in the new cottage on section 10, another in the boarding-house, two in the stone block-house, and still another housed in the old guard-house, gave us five steady men as a nucleus around which to gather our more transient help. During the winter months the number of men employed was nine, which force was increased in early spring for tree-planting work, and again as cropping and harvest came on.

Two changes only occurred in the staff. Mr. J. L. Pelham resigned his position as assistant in horticulture in April and left the Fort Hays Branch Station. He was succeeded by Mr. L. E. Hazen. Mr. J. A. Milham, a graduate of the Kansas State Agricultural College in 1907, was appointed assistant in animal husbandry, beginning work in April, 1908.

As the work of the Hays Station expands, and especially as endeavor is made to do the work more thoroughly, a larger regular force becomes necessary, and it becomes desirable to retain interested, careful, experienced men, who demand a better wage than we can afford to give the average shiftless, careless, time-killing laborer.

The management of the Station workmen's boarding-house has been quite satisfactory, although there have been two changes of operators. Most of the hands, not accommodated in homes of their own, have quarters supplied, but it is found that more room is needed, not only through the busy season of summer, but in the winter likewise.

Respectfully submitted.

C. K. McCLELLAND.

REPORT OF GARDEN CITY BRANCH STATION.

Prof. C. W. Burkett, Director: The Garden City Branch Station comprises 320 acres of land, 40 of which were broken during the year 1907. The remainder of the land is covered with native buffalo-grass. Forty acres of this are fenced for pasture, the remaining 240 acres being unfenced from the adjoining half-section. Of the 40 acres available for experimental purposes 148 tenth-acre plats are appropriated for the experimental work in dry-land agriculture in coöperation with the United States Department of Agriculture. The land not occupied in this work is available for other uses. The lay of the land comprising the Station is variable, ranging from that located in the "shallow water" area, which is adapted especially to crops having deep root-systems, to the upland, which is representative of the larger area of the surrounding country. The experimenting in progress at present is being done on the higher land.

The equipment with which the Station is provided is limited. One building furnishes shelter for the tools and a lodging place for the man in charge. The implements on hand consist of a plow, a disk-harrow, a smoothing-harrow, a grain-drill, a hand corn-planter, a one-horse cultivator, a subsoiler and a light farm wagon. There are two horses.

The operations of 1908 produced practically no results as far as crops were concerned. All plats of the experiments in crop rotations and cultivation methods in coöperation with the United States Department of Agriculture were seeded according to the schedule of the work, and twenty-three tenth-acre plats were also devoted to variety testing of winter grains. The ground at seeding-time, however, was very dry. It had not received any special treatment for moisture conservation since being broken in the spring of 1907, and as there was practically no rain in the fore part of the season the condition of the ground in regard to moisture was very unfavorable for spring grain crops. Rains in June gave later crops a good start, but later dry weather checked the growth of all those except corn and thus gave the Russian thistles a chance to start. These prevented the progress of the crops which might have otherwise survived the dry weather. The corn made a reasonable yield of fodder, as it was kept cultivated, but as no

scales were available the yield was not determined. Kafir-corn, milo maize and cane were sown broadcast and were therefore almost total failures. These crops will be planted in rows and kept cultivated hereafter. The following is the rainfall which was recorded at the Station during the growing season:

	Inches.
April	0.19
May.....	0.78
June	3.34
July	1.64
August	1.61
September.....	0.62
Total	8.18

The schedule of the work in crop rotation and cultivation methods has been followed as closely as possible in preparing for the 1909 crop. The plats which were fall plowed and summer fallowed have been kept disked and harrowed after rains and at present are in fairly good seed-bed condition, notwithstanding the fact that the ground was very dry and hard when plowed. Fall listing and subsoiling are also being tested and it is apparent at present that some very interesting results should be obtained next year. Sixteen plats of winter wheat and seven of rye were seeded during the fall in the rotation and cultivation work and twenty-five have been devoted to variety testing of winter grains. About six acres have also been seeded to Kharkof wheat and Ivanoff rye, the intention being to secure seed for distribution. The land being utilized for variety testing and seed production is land which was kept fallowed during the summer.

Observations during the past season indicate the importance of experiments in dry-land agriculture. Information in regard to crop production under very dry conditions is in demand and it is important that this Station be equipped for making more extensive investigations along this line. For this, men and more horses are needed. For the proper development of the Station a set of buildings consisting of a house, a barn (including a seed-room), an implement-shed and a windmill should be provided. A binder, a gasoline-engine and a small-sized thrasher, a lister, a corn-planter and some wagon scales will be needed during the coming season.

H. R. REED.

REPORT OF THE COÖPERATIVE EXPERIMENT
STATION, McPHERSON.

Prof. C. W. Burkett, Director: Since the last report of two years ago the Coöperative Experiment Station at McPherson has obtained the results of three years' work. The 1906 crop season was a favorable one, so almost all of the grains made a splendid showing. The 1907 crop season was characterized by failures and poor yields. Into the cause of this enter three very adverse factors—the "green bug" (*Toxoptera graminum*), the several late severe frosts and the too long intervals between precipitations. During the crop year there was a deficiency of about three inches in the rainfall, as measured from the normal. The 1908 crop season, on the whole, was more favorable than the preceding one. However, the yields obtained were not what the climatic conditions gave warrant. The causes of this were the thin stands and the Hessian fly. Practically all the seed, both fall and spring plantings, was given the hot-water treatment for smut. In very many cases the severity of the treatment retarded or even practically destroyed the germination. This was true of the wheats especially, and to a lesser extent with the spring grains. The resulting thin stands of grain permitted an extraordinary amount of growth of the wild buckwheat (*Polygonum convolvulus*) to occur. The damage caused by the Hessian fly occurred just before harvest and was estimated to average ten or fifteen per cent.

Previous to the crop year of 1906 for three crop years the rainfall averaged over thirty-nine inches each season. The rainfall for the crop season of 1906 was 30.53 inches, in 1907 it dropped to 28.80 inches, and for the crop season of 1908 it increased to 36.06 inches. The crop season rainfall at McPherson for the past twenty years averaged 31.54 inches. We consider the crop year as corresponding to the fiscal year.

The number of plantings made for the 1907 crop was 1535, of which 980 were fall and 525 were spring plantings. The number of varieties was 1225, which were apportioned as follows: Wheat, 875; barley, 202; oats, 104; rye, 33; buckwheat, 7; proso, 3; and sand-bur, 1. For the 1908 crop the number of plantings was increased to 1689, of which 984 were fall and 741 spring plantings. The number of varieties was increased 61 in oats and 4 in buckwheat and decreased about 100 in

wheats. For the 1907 crop there were 136 tenth-acre plats, 12 smaller plats and 18 larger plats. In addition to this there were 3020 rows of grain in our row-work plantings. Including in the above 6 tenth-acre plats of corn, 5 of alfalfa and 2 of brome-grass, we should have the actual division of the 30-acre field into plats, and have a fair representation for the three crop years.

The plat-work results may be shown in a table.* The yields taken from the tenth-acre plats or smaller plats, and in no case from larger ones. That several poor varieties are included in these averages, that the land has been constantly devoted to small-grain growing, so it is very weedy, and that no attempt has been made to maintain or increase its fertility, should be taken into consideration when studying the yields secured at this station.

CROP.	1906.		1907.		1908.*		Three-year average.....
	Number of varieties..	Average yield.....	Number of varieties..	Average yield.....	Number of varieties..	Average yield.....	
Winter ryes.....	3	31.16	4	13.92	4	24.30	23.13
Spring oats.....	26	41.91	28	4.04	31	21.93	22.63
Winter wheats.....	41	30.13	44	15.05	44	14.80	20.01
Spring barleys.....	26	35.53	24	4.36	25	19.35	19.76
Winter barleys.....		18.17	2	12.87		22.43	17.84
Spring durums.....	5	22.50	4		5	8.80	10.43

In regard to varieties we shall make use of another table to indicate the results which the better varieties have shown. In each class the varieties are listed in the order of their yielding performance.

We wish to call particular attention to the good results secured with our winter types of emmer and spelt. In feeding both of these grains have been found quite equal to barley, while as a mixture with other grains they are highly prized. At present they are remarkably resistant to drought, but usually a percentage winter kills. Our winter einkorn has never been fairly tested. This fall the seed was carefully screened and handpicked. From now on fairer results may be expected. This grain tests about thirty-five pounds to the bushel instead of the twenty-five pounds of emmer and spelt. As there is

* NOTE.—The time of publication of this report enabled Mr. Cory to include results for the harvest of 1908 in this and the succeeding tables, and they are permitted to appear because of the value of the three-year comparisons.

Class.	G. I. No.	NAME.	Yield.			Average.
			1906.	1907.	1908.	
Wheat.....	1571	Turkey.....	40.67	20.63	20.25	27.13
".....	1435	Crimean.....	37.83	22.17	17.29	25.76
".....	1559	Crimean.....		23.63	15.79	19.71
".....	1533	Kharkoo.....	36.21	20.63	19.13	25.32
".....	1442	Kharkoo.....	35.03	20.92	19.50	25.17
Oats.....	165	Sixty Day.....		4.70	49.06	26.83
".....	459	Kherson.....	55.70	6.72	41.17	34.53
".....	451	Texas Red Rust-proof.....	58.62	5.55	36.95	33.67
".....	170	Perm.....	50.23	6.25	37.73	31.40
".....	337	Seventy-five Day.....	49.14	4.92	39.45	31.17
".....	261	Georgia Rust-proof.....	50.47	8.13	31.56	30.05
Barley.....	90	Caucasian.....	51.46	10.42	33.85	31.91
".....	205	Yenidje.....	51.77	4.79	32.45	29.67
".....	182	Odessa.....	44.48	9.95	30.47	23.30
".....	191	Black Smyrna.....	48.91	10.47	17.03	25.49
".....	195	White Smyrna.....	50.63	3.33	22.29	25.42
".....	549	Common.....	40.94	4.11	25.42	23.49
Rye.....	13	Russian.....	29.87	11.02	27.23	22.72
".....	34	Ivanov.....	32.95	12.36	20.80	22.04
Einkorn.....	1226	Winter.....	34.75	16.17	23.42	26.45
".....	1780	Engrain Double (Spring).....	33.30	11.47	34.25	26.94
Emmer.....	2337	Black Winter.....	53.33	31.10	77.00	53.81
Spelt.....	1772	Red Winter.....	49.20	35.60	60.00	48.27
Durum.....	2094	Kubanka.....	25.63		13.46	13.63

more grain in proportion to the hull than in emmer or spelt it should be more valuable for feeding purposes. It is remarkably resistant to drought, is winter hardy and seems to be immune from the very common plant diseases of smut and rust. We believe that this variety will prove successful in many parts of the Great Plains area.

With the belief that the future popularity as grain crops of such grains as oats, barley, emmer and spelt rests largely upon their ability to adapt themselves as winter types, considerable work has been done here in selecting and testing various spring grains as to their adaptation for winter planting. Already it has been partially demonstrated that we have successful types in all of these. However, the winter barleys we have grown have not thoroughly proved their worth for this section; hence we are doing some work at developing new types, of which we already have several of promise. A variety of winter oats which promises to be successful in the Great Plains area was grown this year for the first time east of the mountains. This is a black winter variety of excellent quality, coming originally from England, but grown for the previous eight years in Utah by Mr. Stephen Boswell, and known as Boswell's Winter oats. Its yield of 50.55 bushels per acre, with the exception of the yields of the rotation plats, was the best yield of oats this year. The seed has been distributed to other experiment stations and to a coöperator in McPherson county. We

have a few other varieties of oats that are quite promising as winter varieties.

An interesting experiment may be mentioned here. It is one with thirty varieties of durum wheats, our extra hard varieties, formerly most commonly termed macroni wheats, and which are spring varieties. We do not believe that these wheats as spring grains are adapted to central Kansas conditions, nevertheless we grow them for experimental purposes. The seed was given the hot-water treatment for smut, and then part of it was planted in the fall and another part in the spring. With the exception of a few the germination was retarded and in some cases almost destroyed by the severity of the smut treatment. However, as the germination of the spring planting was not inferior to that of the fall planting, we consider the results of some value, and they are as follows : The spring plantings gave an average yield of 6.55 bushels per acre, while the winter plantings gave an average yield of 18.11 bushels per acre, or almost three times as much. In this experiment one of the winter-sown durums, grown for three years by fall planting, yielded at the rate of 37.57 bushels per acre, which is our highest wheat yield this year.

Two other experiments along this line were also conducted. In one, thirteen varieties of spring barleys, carefully selected with regard to adaptation for winter planting, treated with hot water for smut and planted both in the fall and spring, similar results were obtained. In this case the yields averaged 25.12 and 37.13 bushels per acre, or an average difference of twelve bushels per acre. In the other, five varieties of oats, the seed of which had been grown for two years by fall planting, were planted both in the fall and spring. In the spring planting three of the varieties did not mature seed, which shows the result of growing two years by fall planting of varieties adapted thereto. The winter plantings gave five times the yield of the spring plantings, but counting out the failures in the spring plantings the result is reduced to twice that of the spring plantings. It is difficult to get a good test of this kind with oats.

For the crop of 1907 all the grain was given the formalin treatment for smut. This treatment proved effective with the oats and with the covered smut of barley, but did not lessen the loose smut, our troublesome one, in either wheat or barley. When this result was obtained it was determined to use the

hot water method for eradicating smut. In our experiments the grains were treated as follows: Wheat is soaked in cold water for seven hours, then treated at 54 degrees C. for fifteen minutes ; barley is soaked for six hours and treated for fifteen minutes at 52 degrees C. ; and oats with no previous soaking is treated for ten minutes at 57 degrees C. This year there was no smut in the wheat or oats, while three varieties of barley had a few smutted heads. When we consider the very large number of varieties thus handled the results are quite gratifying. However, we would not treat oats again other than with formalin. We noted that both treatments retarded germination, and in the few checks which we had a slightly lower yield also resulted.

For all three crop years we have grown buckwheats in date-test plantings. This year we grew ten varieties in ten plantings at intervals of one week, beginning on the first Tuesday in April and ending on the second Tuesday of June. For the three years the results have consistently indicated that the earlier plantings are to be preferred. For the ten plantings this year the best variety of buckwheat averaged 15½ bushels per acre, while at the best planting date the varieties averaged 17.14 bushels per acre. Each succeeding year has given us more favorable results with the buckwheats, and they seem to be adapted to sowing in central Kansas any time during the month of April.

For next year's work we will have the ground better prepared than heretofore. Our alfalfa and brome-grass plats have been plowed up and in the spring will be sown to corn, oats and durum wheat. This fall we have discarded 300 varieties of wheat, and have sieved or handpicked, or both, all grain sown in our row-work plantings. The spring grains will be selected likewise. Good results should be the reward of this great amount of work.

Respectfully submitted.

VICTOR L. CORY,
Scientific Assistant, U. S. D. A.

REPORT OF THE CUSTODIAN.

STATEMENT OF RECEIPTS AND EXPENDITURES OF KANSAS AGRICULTURAL COLLEGE EXPERIMENT STATION FOR THE FISCAL YEAR ENDING JUNE 30, 1908.

To the Board of Regents of the Kansas State Agricultural College:

GENTLEMEN—Herewith is submitted my report of receipts and expenditures on account of the Experiment Station for the period between July 1, 1907, and June 30, 1908:

Balance on hand July 1, 1907.....	\$5,878 31
Received from the treasurer of the United States.....	29,000 00
Received from cash sales.....	<u>20,298 87</u>
Total.....	\$55,177 18
Approved vouchers, including credits.....	<u>48,505 12</u>
Balance on hand June 30, 1908.....	\$6,672 06

The following statements of the financial affairs of the Experiment Station are as reported to the United States Department of Agriculture; the several items of this account are covered by vouchers approved by the disbursing officer, certified by the director, and allowed by the president of the Board of Regents :

Experiment Station, Kansas State Agricultural College, in account with United States, appropriation, 1907-'08.

DR.

To receipts from the treasurer of the United States, appropriation for fiscal year ending June 30, 1908, under acts of Congress approved March 2, 1887 (Hatch fund), and March 16, 1906 (Adams fund).....	\$15,000 00	\$9,000 00
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CR.

By Salaries.....	\$10,489 27	\$4,398 36
Labor	2,404 05	2,602 03
Publications.....	177 13
Postage and stationery.....	96 68	34 92
Freight and express.....	221 80	38 94
Heat, light, water and power.....	40 41
Chemical supplies.....	226 24	238 34
Seeds, plants and sundry supplies.....	379 87	206 66
Fertilizers.....	136 00
Feeding-stuffs.....	184 03
Library.....	15 45	4 00
Tools, implements and machinery.....	174 50	290 40
Furniture and fixtures.....	15 75	18 50
Scientific apparatus.....	324 15	598 66
Live stock.....	105 00	93 32
Traveling expenses.....	197 10	4 50
Building and land.....	37 01	246 93
Total.....	<u>\$15,000 00</u>	<u>\$9,000 00</u>

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the Experiment Station,

Kansas State Agricultural College, for the fiscal year ending June 30, 1908; that we have found the same well kept, and classified as above: and that the receipts for the year from the treasurer of the United States are shown to have been \$24,000, and the corresponding disbursements \$24,000; for all of which proper vouchers are on file, and have been by us examined and found correct, thus leaving no balance.

And we further certify, that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, and March 16, 1906:

[SEAL.]

EDWIN TAYLOR,
 J. S. McDOWELL,
 A. M. STORY,

Auditors.

Attest: LORENA E. CLEMONS, *Custodian*.

SUPPLEMENTARY STATEMENT.

The following account shows the receipts of the Station from other sources than the United States, expenditures, and balance on hand:

DR.

To receipts from other sources than the United States for the year ending June 30, 1908:	
Balance on hand July 1, 1907.....	\$5,878 31
Sales and fees.....	20,298 87
Total	<u>\$26,177 18</u>

CR.

By salaries	\$150 00
Labor	6,802 91
Publications	301 79
Postage and stationery.....	830 20
Freight and express.....	542 63
Heat, light, water and power.....	152 00
Chemical supplies	938 90
Seeds, plants and sundry supplies.....	3,118 27
Feeding-stuffs	597 48
Library	9 04
Tools, implements and machinery.....	319 27
Furniture and fixtures.....	446 00
Scientific apparatus	1,121 17
Live stock	424 29
Traveling expenses	1,327 97
Contingent expenses	73 47
Buildings and land.....	2,349 73
Total	<u>\$19,505 12</u>
Balance	<u>6,672 06</u>
Grand total	<u>\$26,177 18</u>

Respectfully submitted.

LORENA E. CLEMONS, *Custodian*.

REPORT OF THE AGRONOMIST.

Prof. C. W. Burkett, Director: The Agronomy Department as at present organized includes four general lines of study or investigation, as follows: Crops, soils, farm mechanics, and farm management. The experimental or investigational work is being carried on largely with the first two subjects named. However, some special investigations in farm mechanics were begun during the past year, relating especially to the testing of planters, drills and grain-grading machinery. These experiments include not only a comparison of the different machines but are also intended to determine the importance of grading seed-grain and seed-corn for general field culture. The department has also been carrying on some general farm management work, related mainly to soil improvement, as regards the reclaiming of waste land, damming of draws and ditches to prevent washing, and the leveling of rough lands in order to bring them into better farming condition.

The main lines of experimental work with crops and soils—as outlined in previous reports, is being largely continued and the work of the past year may be briefly outlined as follows :

VARIETY TESTS.

The variety testing has been reduced somewhat in amount, the plan being to eliminate all inferior varieties after two or three years' trials. However, it seems necessary to test a number of new productions with a number of old standard sorts each year as a comparison or check on the new varieties—during the year tests were made with 220 different varieties of the several farm crops, including 80 of corn, 50 of wheat, 25 of oats, 20 of barley, and a number of varieties each of sorghum, Kafir-corn, cow-peas, soy-beans, millet, flax, etc. It seems necessary to continue this work, for two principal reasons, namely, to test novelties or highly advertised varieties, such as the "Alaska" wheat, "Miracle" wheat, "Egyptian" corn, and "Oregon" winter vetch, etc., which the seedsmen bring on the market and offer at a very high price and the value of which must be determined by testing at the Experiment Station in order to prove the value and adaptation of these new productions and protect the farmer. Again, the breeding of crops by the Experiment Station is continually developing new strains or varieties which must be tested in comparison with the old

standard sorts to prove their value before seed is finally propagated and distributed for general growing.

CROP IMPROVEMENT.

Under this head may be considered the breeding, by the "head-row" and "ear-row" methods, of corn and sorghums, including Kafir-corn, sorghum, broom-corn and milo, and of wheat and other small grains. In 1907 the "head-row" breeding work included twelve varieties of wheat, two of winter barley, one of winter rye, three of spring wheat, three of oats and one of emmer. Of these several grains and varieties, 606 different heads were selected and thirty grains of each planted in separate rows in breeding plots and the yield and quality of the grain from each separate head-row was determined and the seed from the best-producing heads saved for further planting and propagation, by which method we shall be able to secure improved and pedigreed strains of some of our best-producing varieties of the standard grains.

The department is breeding nine of the leading varieties of corn by the ear-row method, as follows: Kansas Sunflower, Reid Yellow Dent, Hildreth, Hogue Yellow Dent, Legal Tender, Leaming, Boone County White, Roseland White, McAuley White Dent and White Injun. From these several varieties 425 ears were selected and the kernels from each ear planted in separate rows in nine separate fields, and the data were determined from each row, both as to yield and quality of grain produced. The best ears from the high-producing rows are again used in the breeding plots and the second selection is used as general seed for planting the increase plots to produce seed to be used for distribution. In a similar manner are being bred four varieties of sorghum, two of Kafir-corn, one of milo maize and two of broom-corn. The seed from 325 selected heads of these several crops were planted on separate rows in separate fields for each variety. Thus the total number of ear-rows of corn, etc., planted last season, was 750. Some breeding work is being done also with millet and the annual legumes—cow-peas and soy-beans. The seed from selected single plants of one variety of each of these crops is being planted in separate rows each year. This work last year included the planting and harvesting of sixty-nine separate rows.

This breeding work requires a large amount of time and careful attention, and one or more special assistants are con-

tinually employed in this work alone. In the judgment of the writer, however, there is no more important work being undertaken by this Experiment Station than the improvement of our standard crops by the breeding methods as outlined above. The purpose of all this breeding work was originally, and still is, in part, to secure purer strains of the best-producing varieties of the standard crops, the ordinary seed being very impure and badly mixed. However, in the progress of the work it is possible to secure not only purer strains, but pedigreed strains having a capacity to produce larger yields and a better quality of grain, and the ultimate purpose is to separate the seed of good quality produced by the high-yielding rows and eventually make these plants the founders of new and improved strains or varieties, which will be propagated and the seed distributed to the farmers of the state.

DISTRIBUTION OF IMPROVED SEED.

It has been the plan of the department for several years that as soon as a variety was shown to be hardy and a better producer than others to improve this variety by breeding and selection, with the purpose of increasing it and distributing the seed to the farmers of the state. During the past year the department has sold and distributed 1691 bushels of good seed wheat of these improved best-producing varieties, 157 bushels of an improved strain of Tennessee Winter barley, 341 bushels of well-bred seed-corn of eight different varieties, some 50 bushels of dwarf milo maize and selected broom-corn, 105 bushels of sorghum seed, 110 bushels of oats, 30 bushels of flax, and 30 bushels of cow-peas and soy-beans, making a total of 2707 bushels of well-bred seed of the better-producing varieties as shown by the tests at this station. The department is growing or having grown under its direction this season (1908) some 130 acres of high-bred corn, 90 acres of well-bred wheat, 15 acres of oats, 15 acres of winter barley, 5 acres of spring barley, 27 acres of Kafir-corn, sorghum, milo, and broom-corn, 10 acres of cow-peas and soy-beans, 8 acres of flax and 4 acres of millet, or a total of 304 acres, and in connection with the growing of these crops for seed production various experiments are also being conducted, as outlined in this report.

These seeds are sold at a good price—usually about twice the market price—and the seeds offered for sale by this department

have been in great demand and the work has been well appreciated by the farmers, very few unfavorable reports having been received from the growers of college-bred seed. Often farmers report yields of twenty-five to thirty per cent. above that secured from home-grown seed sown in the same field or in adjacent fields.

There is little question but that the sale and distribution of well-bred seed of these best-producing varieties has had a marked influence in increasing the yield and improving the quality of our several standard crops, especially wheat and corn. In the judgment of the writer this work is of vast importance to the state. The Experiment Station should be the center for crop improvement and the distributing point for well-bred seeds. Improvement of crops by breeding and selection is a work which the general farmer cannot well undertake, although he may grow the high-bred seed and thus become a further distributor of the improved seed-grain.

ROTATION EXPERIMENTS.

The rotation experiments with corn have been discontinued. The field upon which this work was being conducted was a rented one and was sold, thus passing out of the control of the department. These experiments were giving some very interesting results and it seemed very undesirable to discontinue them. The fact is mentioned, merely to call attention to this very undesirable condition under which the Agronomy Department has been obliged to carry on much of its work, namely, that of using rented land for experimental purposes.

The rotation experiments with wheat are being conducted on a field belonging to the College and are being continued as outlined in previous reports.

SOIL CULTURE.

Two general plans of experimentation are being carried on in soil culture, namely, seed-bed preparation and crop cultivation. The testing of different methods of preparing the seed-bed for corn includes early plowing, listing and disking and a comparison of methods of planting with the lister, surface planter and disk furrow-opener attachment to the surface planter. The seed-bed preparation experiments with wheat include early plowing and cultivation with the harrow, Acme harrow and disk; disking without plowing or stubbling in the wheat; late plowing and deep and shallow plowing. The gen-

eral purpose of the experiment is to study the conservation of soil moisture as affected by the different methods of seed-bed preparation. Temperature studies are also being made in connection with these experiments, and some very important results are being secured. The yields from plots which were given special cultivation last season in some cases were double the yields from plots which received little or no cultivation previous to planting.

The cultivation experiments are mainly with corn and include deep and shallow cultivation; combinations of both; right and wrong time to cultivate, and cultivation with different kinds of cultivators. Previous experiments indicate that the depth or method of cultivation has less to do with securing a large yield than the time of cultivation, hence the experiment, "the right and wrong time to cultivate."

On account of the dry spring, followed by the continuous wet weather, the experiments in harrowing wheat and other small grains were discontinued last season.

SOIL FERTILITY.

Fertilizer experiments were continued with wheat and oats during the past year with marked results favoring the use of barn-yard manure. However, certain chemical fertilizers or combinations of chemical fertilizers have also given increased yields, nitrates and phosphates showing a marked effect, especially with wheat. A new fertilizer experiment has been undertaken with alfalfa, the purpose being to determine the comparative effects of barn-yard manure and combinations of chemical fertilizers applied to worn land, to the previous crop, on the starting and growth of newly seeded alfalfa. The results of the first year's work are wonderfully in favor of the use of well-rotted barn-yard manure in starting alfalfa on old worn upland, the yield of alfalfa the first year from the manured plots being more than double that secured from the plots which received no fertilizer.

BIND-WEED EXTERMINATION EXPERIMENTS.

This work is being undertaken by the order of the director in accordance with the act of the legislature appropriating \$1000 for bind-weed extermination experiments in western Kansas. The experiments in charge of this department are being carried on in coöperation with Andrew Sander, on his farm near Victoria, in Ellis county. Two general plans of exter-

mination were undertaken last season, namely, different culture methods and the use of smother crops. All the culture methods last season practically failed to destroy the bind-weed. There is some promise, however, that by winter plowing and the proper use of smother crops, such as sorghum and Kafir-corn, the bind-weeds may be destroyed, or at least weakened in vitality and greatly reduced in numbers.

A preliminary report of the progress of this work has been published in circular form by this department, and republished in most of the papers of the state. These experiments and others are being continued in 1908.

SEED-WHEAT INVESTIGATION.

In carrying out the provisions of the seed-wheat bill passed by the state legislature authorizing the investigation of seed wheat, the writer visited the province of Alberta, Canada, in August, 1907, and made a study of the growing of winter wheat in that province, publishing Press Bulletin No. 157 as a result of his investigation.

Samples of wheat were obtained from Alberta and a number of the Alberta samples were planted in trial plots last fall. The Russian samples obtained by the director were not received early enough for planting. A large number of samples, however have been received and will be planted in the fall of 1908. The purpose is to test these samples as regards yield, quality, purity, etc., previous to securing large importations of seed.

COÖPERATIVE EXPERIMENTS.

The coöperative tests of grains with farmers was in part discontinued last year, due to lack of assistants and funds. The work was continued with six farmers located in various sections of the state, whose work had been most satisfactory in previous years. Aside from this testing of varieties, several of these farmers were supplied with several bushels of pure seed of wheat, corn and other grains of those varieties which had proven most successful with them, in order that they might grow and distribute seed of these different varieties in their several localities.

The department is this season (1908) coöperating with some sixteen substations and state experiment stations in other states, as follows: Kentucky, Georgia, Virginia, Missouri, South Carolina, Ohio, Arkansas, Tennessee, Mississippi, Iowa, Maryland, Illinois, and the Kansas substations at McPherson,

Garden City and Hays. A number of samples of our well-bred corn was sent to each of these stations last spring, the purpose being in part to learn to what extent Kansas seed-corn is adapted for growing in other states and whether it is superior to the home-grown corn of the several localities.

The reputation which the department has established by the distribution of well-bred seed has reached even to foreign countries, and at the request of experiment stations and others samples of our best-producing varieties of corn, wheat and other grains have been sent (usually in exchange for other seed-grains) to Russia, Australia, Philippine Islands, Germany, India, Italy, Alaska, Canada, Mexico, Chili, Peru and other South American countries.

OTHER EXPERIMENTS.

A new and important series of experiments was begun last spring in the grading of seed-grain and seed-corn for field planting. Along with the grading of corn, a test of planters was made. The machine-graded corn was planted with four different planters in a comparison with "whole" corn (including butts and tips) and with seed-corn from which the butt and tip kernels were removed by hand.

Grain-grading experiments with the fanning-mill were begun with oats last spring and will be continued with wheat this fall, the plan being to separate the seed-grain into two grades, the heavy and the light, each of which is planted in separate plots and compared with the ungraded grain, which is planted in a third plot as a check. To check and prove the work and compare the individual light and heavy grains, 900 grains of each grade were planted by hand, a single grain in a place, in separate rows or plots. This should be a very important investigation, and it is hoped that it may be continued long enough and so carefully conducted that the results may give conclusive proof regarding the value of grading grain for general field planting, which is now a subject of dispute.

Other experiments are being conducted in cutting and storing alfalfa hay, including stage of maturity to cut alfalfa for hay and the storing of green alfalfa in the shed. The first experiment is being undertaken in coöperation with the Chemical Department of this Station and includes a chemical analysis of the alfalfa at different stages of growth when it is cut for

hay. The storing of green alfalfa in the shed has not been fully successful but the work has given valuable suggestions for further experimentation.

Respectfully submitted.

A. M. TENEYCK.

REPORT OF ANIMAL HUSBANDMAN.

Prof. C. W. Burkett, Director: I beg to report that the work of the Animal Husbandry Department for the year ending June 30, 1908, has been similar to that of the preceding year, in that many of the experiments were duplicated. New work has been taken up in alfalfa feeding, and especially in making comparisons of alfalfa-meal with alfalfa hay for horses, cattle, sheep and swine.

HORSES.

The only work done with horses was observations made on the feeding of alfalfa-meal in place of wheat bran to broodmares and work horses.

CATTLE.

The work of the preceding year with show steers was continued through this year. This work consisted in comparing the cost of gains on two-year-olds, yearlings and calves kept and fed for show purposes.

Another experiment was conducted with a car-load of steers. One half of them were fed on alfalfa hay for roughage and the other half on alfalfa-meal with corn-and-cob meal as the grain ration for both lots.

Observations were also made in the feeding of alfalfa-meal in place of bran to breeding cows.

SHEEP.

An experiment with sheep was conducted in comparing alfalfa-meal and alfalfa hay with corn as a fattening ration for Mexican sheep. The alfalfa-meal was also fed to spring lambs and breeding-ewes. Another experiment with sheep was conducted to ascertain the effect of shearing upon fattening sheep. One half of the lot were shorn before the experiment began and the other half were fed with the fleece on.

HOGS.

Observation was made throughout the year on the feeding value of alfalfa hay, alfalfa-meal and alfalfa pasture for growing and breeding hogs.

The first experiment of the year was with eight lots fed on the following rations:

- | Lot Nu. | Ration. |
|---------|--|
| I. | Corn-meal. |
| II. | Corn-meal and International Stock Food. |
| III. | Corn-meal and Pratt's Stock Food. |
| IV. | Corn-meal and Hercules' Stock Food. |
| V. | Corn-meal and whole alfalfa hay fed in the rack. |
| VI. | Corn-meal, 70 parts; shorts, 25 parts; Swift's Meat Meal, 5 parts. |
| VII. | Corn-meal, 6 parts; alfalfa-meal, 1 part. |
| VIII. | Corn-meal, 90 parts; Swift's Meat Meal, 10 parts. |

The second experiment was in part the duplicate of the first and consisted of five lots fed on the following rations:

- | Lot No. | Ration. |
|---------|--|
| I. | Corn-meal, 6 parts; alfalfa-meal 1 part. |
| II. | Corn-meal, 6 parts; alfalfa-meal, 1 part. (Ration was soaked twelve hours before being fed.) |
| III. | Corn-meal, 9 parts; meat-meal, 1 part. |
| IV. | Corn-meal, 70 parts; shorts, 25 parts; Swift's Meat Meal, 5 parts. |
| V. | Corn-meal; alfalfa hay, fed in racks. |

It is the intention of the department to continue the work with alfalfa throughout the coming year, and in connection with the Chemical Department digestion tests are being made on the digestibility of the feeds that have been used.

Respectfully submitted. R. J. KINZER.

REPORT OF THE BACTERIOLOGIST.

Prof. C. W. Burkett, Director: Since the beginning of this department, in 1907, most of the experimental work has been directed toward two problems: one in pathological bacteriology and the other in soil bacteriology. It is the purpose of the department, as soon as opportunity offers, to begin the prosecution of some practical problem in dairy bacteriology.

PATHOLOGICAL BACTERIOLOGY.

Hog-cholera Vaccine.—During the year a series of experiments was undertaken to determine the efficiency of certain methods of procedure in immunizing hogs against the disease of hog-cholera. The line of work which is being pursued in this department is that of so attenuating the hog-cholera virus by passing it through some animal other than the hog that it may be used as a vaccine. Certain results heretofore obtained have been verified. It has been found that virulent serum kept at a temperature of fourteen degrees C. (ice-box) after a period of nine months loses its infectious qualities. Results

also show that the virulent hog-cholera serum after being kept for nine to ten months in the dry form will not produce the disease in healthy hogs. On the whole, the results of experiments in vaccinating hogs have progressed satisfactorily and the department proposes to do some field-work during the fall months with an experimental vaccine.

Hematology.—Together with the above work on hog-cholera, a comparative study is being made of the histological structure of the blood of hogs suffering from hog-cholera and that of normal hogs.

SOIL BACTERIOLOGY.

Deep and Shallow plowing. —For the past six months the department has conducted an investigation on the influence of deep and shallow plowing on the bacterial content of the soil. Two types of soil, opposite in character, have been used. Results show that deep plowing increases the number of bacteria. The rate of increase, according to depth, is more uniform in silt soil than in sandy soil. The various activities (nitrification, ammonification, gas production, etc.) of the bacteria found under different conditions are being determined. The individual species of organisms making up the flora are being described and identified.

Gravimetric and Volumetric Methods. —Because of the absence of standard methods in soil bacteriology, both gravimetric and volumetric methods of taking samples are used by different investigators. Both methods present certain inaccuracies. With the purpose of finding which of the two technical procedures is the more accurate, a comparative study is being made of the gravimetric and volumetric methods of bacteriological soil analysis.

Respectfully submitted.

WALTER E. KING.

REPORT OF THE BOTANIST.

Prof. C. W. Burkett, Director: The Botanical Department has practically confined its work during the past year to the breeding of wheat and alfalfa. The pedigree breeding of these plants is now firmly established with us, and, especially in the case of wheat, has developed to considerable proportions. Beginning in the spring of 1906, we selected in the field 536 single heads from promising plants growing in some 600 plots

of so-called "varieties" of wheat imported from all the chief wheat-growing regions of the world. Some fifty characters, of which about twenty-five were quantitative, were determined for these heads, and recorded on specially prepared blanks. The seeds from all of these pedigree plants were planted in separate rows. In addition, for the special study of changes in the grain characters, sixteen lots, containing 100 kernels each, coming from various well-marked types of wheat of distinctly different physical characters, were planted, each grain being numbered and planted separately, the length, breadth, specific gravity, volume, weight and color of the kernel having been previously determined. Last season all of the plants coming from the pedigree-head selections were again put through the same careful and complete system of laboratory measurements as before, to which the plants growing from the measured grains were likewise subjected.

As the result of our efforts, we now have complete plant records for pure-bred wheat plants covering nearly 1500 strains, for one, two and three years, of which about one-third have been carried through two and a somewhat lesser number through three years of pedigree breeding. From the data thus collected we have been able to determine some of the facts in respect to heredity and variation in wheat. The first of our publications concerning the physical characters of the wheat kernel is nearly ready for publication and deals specifically with the changes in hard wheat resulting in the "yellow berry." The progeny obtained from the pedigree wheats were planted again last fall, and this time, in order to establish a yield test for purposes of comparison, 250 grains of each pedigreed plant were sown, equidistant, in sixty-six foot rows. These rows were made to alternate across the field with rows similarly planted of a wheat known as Kharkov, not of pure-bred or pedigreed stock, but belonging to a reasonably pure race of hard, red, bearded, white chaff wheat of the Turkey type, which has been grown by the Department of Agronomy of this Station for several years, and which has been found to be the highest in yield of the various sorts grown by that department.

By this system of planting we shall this summer be able to eliminate all of those pedigreed wheats that do not at least equal the yield record of the adjacent rows of Kharkov except where, for scientific reasons, or for purposes of crossing, cer-

tain of the others are required. From the data thus carefully collected for three seasons we shall study the correlations between certain selected pairs of characters in wheat, our aim being to determine what morphological (botanical) characters in the various organs of the plant are definitely connected in a hereditary way, and particularly in what way the grain characters are associated with, and vary with, the other characters. The problem of the acclimatization of wheat can be solved in no other manner.

In alfalfa breeding we began with several hundred plants selected for breeding purposes out of a considerable field in which alfalfa seeds of two standard "varieties" were sown, at the intersection of cross-lines two and one-half feet apart, and thinned, after they had begun to grow, to one plant in a hill. In this field it was at once seen that remarkable differences existed among the plants in respect to habit of growth, leafiness, form, size and color of the leaves, and color of the flowers. It was at once apparent that the existence of great differences in forage value per acre was indicated by these plants, and also by plants growing in fields of alfalfa as ordinarily planted. To determine these differences and to establish superior strains of pure-bred alfalfa, the selections were made. Extensive field studies were carried on last season, resulting in the discovery of a rapid method of hand pollination of alfalfa flowers, and in a practical and convenient method of determining the relative rates of transpiration of water from alfalfa plants of different types. These results were published in a bulletin entitled "Alfalfa Breeding: Materials and Methods." From selected alfalfa plants kept under wire cages during pollination, and pollinated exclusively by hand, about twelve distinct types or strains of pure-bred alfalfa have been isolated, and are now growing in rows in considerable numbers. These plants will not be allowed to set seed until their second season.

The immense importance to the state of securing pure races of agricultural plants of higher value cannot be overestimated. We have found it necessary thus far to concentrate ourselves upon wheat and alfalfa as the plants of chief importance.

From the results thus far obtained, the writer can say that, properly supported, the Botanical Department can in a few years supply in bulk pure-bred seeds of strains of wheat and alfalfa superior in yield to the wheat and alfalfa now grown in

the state. In addition we are now in a position to solve some important underlying problems in the breeding of these plants, upon which future operations will depend.

The work of the Botanical Department in connection with plant diseases needs extension. It has thus far been absolutely impossible to spare the funds for a field agent to travel over the state, visit the important fruit, trucking and grain-raising regions of the state, taking notes and collecting material for the study of the plant diseases infesting our various crops. Such information and material we have been obliged to collect spasmodically and through the occasional sending in of diseased plants by correspondents. It is the writer's desire to employ a field agent for plant-disease work alone, to map the state into areas covering the various chief crops, and have such an agent visit these regions at regular intervals during the growing season, take notes, collect material, arrange for spraying experiments, and organize a system of local correspondents.

Our work in inspecting seeds for farmers has proceeded as before. We need distinctly a state appropriation for this work. Seed-control is now an established feature of station work in every European state, and should be in every state in America for the protection of the farming public.

In conclusion I beg to make a special recommendation for the purchase of land for the plant-breeding work of this department. We should have about twenty-five acres, conveniently situated, on which our pure-bred races of wheat and alfalfa can be raised under the supervision of the department. It is hoped that such a tract can be obtained at an early date.

Respectfully submitted.

H. F. ROBERTS.

REPORT OF THE CHEMIST.

Prof. C. W. Burkett, Director: The work of the Chemical Department has been very much greater the last year than ever before. This increase has been due largely to the new feeding-stuffs law, which brought to us the work of analyzing over 1000 samples of registered feeds, beside a large number of inspection samples. We have installed apparatus and systematized the work so as to reduce this labor to the minimum, but we are much handicapped by reason of lack of space.

October 1, 1907, the new fertilizer law went into effect, and

this has brought us a certain amount of analytical work. The number of brands of fertilizers on sale in the state is not large, but the selling points are widely scattered. We are doing inspection work for fertilizers at the same time with that of the feeding-stuffs.

Owing to the prospective changes in the feeding-stuffs law and to the resignation of Professor Mathewson, the inspection work in the fall of 1907 was curtailed, but with the adoption of revisions to the feeding-stuffs law an inspector was placed in the field about April 1, and has been kept busy ever since. Comparatively few cases of flagrant adulteration have been found, due in part, doubtless, to our continuous pressure upon the matter through correspondence the past year. It appears, however, that a large portion of the bran placed upon the market is mixed with the scourings and screenings produced in the mill. As the sale of such feed under the name of bran is a violation of both state and federal laws, it will be necessary to give special attention to this matter next year.

The investigation in connection with the milling qualities of wheat and the baking qualities of the flour yielded by it has been continued upon twelve samples of Kansas wheat and several samples obtained from other states for the purpose of comparison. The Kansas wheats that we have had under treatment are so uniformly good that we hope to obtain more light on the question of the characteristics that influence baking qualities by the comparative study of flours from other wheats. Each wheat in milling is separated into five products, namely, patent flour, break flour, tailings flour, bran and shorts. Valuable data have been obtained in reference to the making of milling tests.

It has seemed to us that the baking test lacks much in exactness and an attempt has been made to add to its accuracy by the use of a special baking-pan designed for this purpose. By means of this it has been possible to obtain much more accurately measured results. Baking tests have been made on the patent flour from twenty-eight wheats, using 340 grams of flour in the new pan, and upon the three grades of flour from the twenty-eight wheats in a small size of the pan, requiring only 100 grams of flour. Protein and gliadin determinations have been made on most of those wheats and flours, but some still remain to be made.

As likely to throw light upon the problem of ascertaining

what determines the baking qualities of flour, the effect of germination of the wheat on the milling and baking qualities has been studied. Wheat was kept under conditions suitable for germination for different lengths of time, after which each sample was carefully dried and milled, and the resulting flours subjected to baking and chemical tests. In all cases a deleterious effect was observed on the milling qualities. Germination conditions for as long a period as three days affected the baking qualities but little; beyond that time the flour became weaker and weaker, resembling that from soft wheat. The effect of adding all the water that the wheat would absorb and allowing it to remain moist for different lengths of time at a low temperature was also observed. This treatment affected the baking qualities of the flour yielded by the wheat but little. In a duplicate set the wheats were heated in addition to the water treatment, with a very marked injury to the baking qualities. In all over 160 separate baking tests and 47 milling tests have been made.

The remodeling of a portion of the old stone barn for use in conducting digestion and nutrition experiments has been completed as far as our present plans extend, and the tests of prairie hay and alfalfa hay contemplated have begun. Prairie hay is a very important roughage in the West and almost no work has been done touching its digestibility and nutritive value. It is hoped that experiments may be carried out upon the different species of domestic animals in order that we may supply the missing data concerning this hay. We have also planned to make studies of a similar character upon alfalfa hay which touch the different forms of that feed, depending upon mode of curing, time of cutting, etc. The effect, if any, of converting the hay into meal, we hope may also receive adequate attention. The experiments thus far have been with sheep and we began upon an excellent example of upland prairie hay. This was subjected to three successive experiments of eight days' duration each, in the last of which the urine was collected and analyzed in addition to the analysis of feed and feces, in order that a determination of the nitrogen balance might be calculated. A similar set of three experiments was then carried out with the same animals upon a ration consisting one-half of the same prairie hay as previously used and one-half alfalfa hay. The same animals will be in the immediate future put upon a ration of the alfalfa hay only, then

a trial will be made of alfalfa-meal, and finally one of black alfalfa hay. The purpose of the three successive experiments is to ascertain whether or not the animal organism adapts its digestive powers so as to utilize rations more completely as their administration continues.

In coöperation with the Department of Agronomy we are securing samples of alfalfa at different stages of maturity under a plan to make complete analyses of them, including complete analyses of the ash, in order to obtain for this study much-needed statistics concerning this crop and its relation to soil fertility in this state.

A study of soil fertility in connection with the Department of Dairy Husbandry has also been undertaken. That department is operating a small dairy farm on a plan which it is expected will be continued for many years. The soils of several fields and pastures involved have been carefully sampled, and it is proposed to observe the changes in composition that ensue under the management carried out upon this farm.

Respectfully submitted. J. T. WILLARD.

REPORT OF THE DAIRY HUSBANDMAN.

Prof. C. W. Burkett Director: I herewith submit a report of experimental work for the Department of Dairy Husbandry during the year ending June 30, 1908.

The changes that have taken place in the department during the year have been such as to interfere with securing the most effective results. Professor Erf, head of the department, was away on a leave of absence during the first three months and, on his return, resigned, and the office was not filled until January 1, 1908. Mr. D. M. Wilson, who was assistant in the department, resigned January 1, and his position was filled by the appointment of Mr. Earle Brintnall, who took up the work February 1, 1908.

DIVISION OF DAIRY PRODUCTION.

Experiments with the milking-machine had to be discontinued, owing to the few animals left after the sale of unprofitable animals that had been kept in the herd for experimental purposes. This line of work will be resumed during the coming year, as soon as a sufficient number of animals can be secured to warrant the use of the machine.

It is hoped to carry out a number of valuable experiments during the coming year bearing on the economical production of dairy products.

CREAMERY DIVISION.

Experiments have been conducted to determine the efficiency and adaptability of moisture testers for ascertaining the moisture content of butter. These experiments have been especially valuable, since there has been such a demand for information along this line, due to the activity of the Internal Revenue Department of the government in enforcing the law relating to the moisture content of butter. The department has also designed a simple, inexpensive tester to be used by the butter-maker in making these moisture determinations.

An exhaustive study has been made of the methods of making the Babcock test for cream. The demand for work along this line has been urgent, owing to the existing method of buying and handling cream in the state. Valuable results have already been secured.

POULTRY DIVISION.

Experiments in feeding poultry have been continued. Wheat combined with casein, meat scraps and dried eggs has been compared with feeding oats combined with casein, meat scraps and dried eggs, corn included with both combinations of feed.

The second year of the egg-laying contest has been completed.

Respectfully submitted. J. C. KENDALL.

REPORT OF THE ENTOMOLOGIST.

Prof. C. W. Burkett Director: I beg to submit the following report of the work of the Department of Entomology and Zoölogy for the year ending June 30, 1908.

RECORD OF NOXIOUS INSECTS AND RODENTS.

Hessian Fly.—This standard pest of wheat was found last fall to be depositing great numbers of eggs on the blades of the regular crop in the southern part of the wheat belt. As winter approached, growers began to detect the damage and to write for measures of combating. Little could be done, for anything that would destroy the flaxseed in the stalk would also destroy the wheat plant. The damage done by the fall brood was in many cases so great that infested wheat-fields were planted to corn the following spring. In March the

"flies" emerged from the flaxseeds in great swarms and the healthy wheat plants in many sections were speckled with eggs. Before harvest it became perfectly plain that fly injury was going to be serious, and when the wheat was ripe, conservative estimates placed the loss at not less than ten per cent. of the acreage sown.

While the fly seems to have been present in all parts of the wheat belt, it has done the most serious damage in central Kansas and southward to the southern boundary of the state. The parasitic enemies of the pest are present in practically all the seriously infested districts and may eventually overtake the fly and reduce its numbers to a point where the growers will not notice its work. But no one can say when that will happen, and in the meantime, the farmer must exert himself to prevent harm to his crop. There is a good prospect for fly damage in 1908-'09 in infested districts where the growers have made no effort to combat the insect.

Corn-ear Worm.—Last fall an examination revealed the fact that most of the corn-fields about Manhattan were badly infested with corn-ear worms. In many cases fully 90 per cent. of the ears had been injured by one or more worms. Some of the worst infested fields showed almost 100 per cent. of the ears thus injured. Traveling over the state late last fall and last winter revealed the further fact that the corn had been similarly injured almost everywhere. Nor is the damage in the fall of 1908 likely to prove any smaller. The damage is not confined to the number of grains the worm destroys, but is partly due to the effects of molds and rots that follow the worm's attack. According to the Veterinary Department of the Station, wormy corn is an especially dangerous food for horses, because certain of the molds are poisonous, producing symptoms of blind staggers. The damage due to the insect is so wide-spread and serious, and such measures as we have for combating are so impracticable, that a careful study of the insect's habits and life-history should be made with a view to finding better methods of control.

Chinch-bug.—This well-known pest of staple crops made its appearance in unusual numbers during the late summer and fall and complaints poured into the office in a steady stream. It was first the corn that was suffering, then the sorghums and Kafir-corn. At the time the chinch-bugs went into hiber-

nation last fall the prospect of serious trouble this summer from these insects seemed particularly good. When the complaints of chinch-bug damage to growing wheat began to come in before the beginning of the late spring and early summer rains, it seemed that the promise of the preceding fall was to be realized. But the rains came in great abundance and millions of the young bugs perished; fungous disease seized upon old and young and they died by myriads, until what promised to be a serious chinch-bug year will prove the least serious of any for some years past.

Greater Wheat-straw Worm.—A few of these insects were noted in the spring of 1908 but little was thought of their work until in May, when we found them laying eggs in the wheat stems and received them from our correspondents. A correspondent in one locality stated that the greater wheat-straw worm was doing quite as much damage as Hessian fly. This insect is apparently not a difficult one to control and no grower should permit it to lighten his crop.

Green Bug.—Except for the fact that this insect attracted such wide attention in the spring of 1907, there would be no reason for mentioning the real "green bug" as one of the insects of the year from June 30, 1907, to June 30, 1908. The green bugs disappeared in May and June of 1907 and were not known to be working in damaging numbers within the confines of the state until the following fall, when they were discovered to be damaging some fields of wheat in Leavenworth and Jefferson counties. Their parasitic and predaceous enemies were with them in considerable numbers, but were unable to destroy them. Throughout the winter the tender green lice remained alive in the fields, but were swept away the following spring by their enemies from all these localities except one, where they were finally plowed under. No considerable damage resulted from their presence in the state this year.

Two other species of green lice were present on the wheat last fall, winter and spring without appearing to do much damage. At Manhattan the European grain-louse (*Siphocoryne avenae* Fab.) appeared on the roots of early-sown wheat in sufficient numbers seriously to check its growth. Throughout the winter a larger grain-louse, the English or German grain-louse, was to be found on the wheat, and in the spring did some harm to the heading grain.

Fall Army-worm.—During September of 1907 numerous reports of the work of this insect on alfalfa came to this office, and investigation showed that the insects had begun their work in spots, frequently far removed from the borders of the field, proving that they had hatched from eggs deposited in the alfalfa. They entered the soil for pupation by September 14 and the majority had emerged as moths by September 28. The moths were seen flitting about among the young alfalfa plants, but no eggs were found.

Fall Web-worm.—The webs of the second brood last fall and the first brood this spring were in evidence, but not sufficiently abundant to cause much complaint.

Elm-twig Girdler.—Last fall, during September and October, this office received many reports of damage to elm trees. Sound branches, sometimes three-fourths of an inch through and bearing a number of smaller branches in full foliage, were cut away until the ground became littered with the debris. In the vicinity of Manhattan the same phenomenon was to be seen. This was the work of the elm-twig girdler. This insect is one that is easily controlled and no one should permit his trees to be seriously injured by it.

Pocket Gopher.—The attacks of this animal became especially noticeable last fall and large numbers of complaints were received at this office. Indeed, many fields were so thoroughly burrowed that the observer could walk from one end to another by stepping from gopher mound to gopher mound. Five hundred seventy-five quarts of liquid gopher poison were manufactured and distributed to the people of the state. Uniformly successful results seemed to follow its proper application.

Prairie-dogs.—Some of the western counties are still afflicted with prairie-dogs, and during the winter 1100 quarts of the liquid poison were sent out.

EXPERIMENTAL WORK.

Although much valuable work has been done on the principal insects injurious to staple crops, the fact that the Hessian fly still destroys annually 10 per cent. of the country's wheat crop, the chinch-bug 2 per cent. of its corn (not to mention the damage to wheat, sorghum, Kafir-corn, and grass), the corn-ear worm 2 per cent. of the annual corn crop, and that plantlice are able to ruin hundreds of acres of corn and wheat, clearly indicates that there is abundant room for further work.

Kansas finds her greatest source of wealth in her staple crops, and it is fitting that her entomologists should devote a large share of their study and experimentation to insects injurious to these.

Insects of such transcendent economic importance should be studied more fundamentally. They should be studied as elements of the environment in which they live. We should determine (1) optimum and fatal points of temperature and moisture for the pests; (2) optimum and fatal points of temperature and moisture for their food plants and for those creatures that use them as food; (3) the modification of these results likely to arise from field conditions of soil and general plant growth. It is entirely probable that such thorough study will suggest more successful means of control.

Special injuries of Hessian fly, corn-ear worm, chinch-bug and plant-lice have led us to plan such a study of them. Owing to the difficulty and delay in getting necessary apparatus we have been compelled to limit laboratory determinations to the careful correlation of temperature and moisture with life-histories.

Hessian Fly.—From the time the large number of eggs found on the young wheat last fall indicated that a year of destructive fly was at hand, we tried to keep in touch with the situation. Mr. Kelly,* jointly representing the United States government and this Station, located this spring in Sumner county, where he made a careful study of the fly's spring emergence and oviposition. Extended notes have been collected on this subject. Mr. Kelly found, as did also Mr. Parker, who had recently been elected assistant entomologist at the Station, that in May many of the flaxseeds formed in the spring gave up adult flies that laid eggs upon the young plants sprouting up from the bases of the older plants. As harvest-time approached it began to seem likely that the Hessian fly would seriously infest wheat again this fall. We therefore planned not only to continue our observation of life-history and habits and parasitic enemies, but also to test methods of destroying the fly in stubble, and to see if by close observation of emergence and oviposition a practicable method of telling when it is safe to sow could be devised. To annul the bias due to local conditions we, in coöperation with Mr. Kelly and a number of live

* During April and May, by special arrangement with the Bureau of Mr. Kelly became joint representative of the bureau and this department.

farmers, have instituted and plan to maintain two series of wheat sowings, each extending across the state from north to south, one in the eastern edge of the wheat belt and one in the western edge. By this arrangement, we shall have northern and southern, eastern and western conditions. This study has consisted of close field-work, supplemented by necessary laboratory study. It is our intention to undertake a careful laboratory study of the fly along lines laid down in the general statement and to bring the results thus obtained to bear on the practical problems raised by the field-work.

Green Bug.—A careful study of this insect and its parasitic enemies, both in field and laboratory, has been carried on. We have determined the green bug's rate of reproduction at different temperatures, and the insect's ability to withstand low temperature. We have determined the rate of reproduction of the principal parasites under different temperatures, and the effect of low temperature on its mortality. We have attempted to determine what other species of plant-lice this parasite can feed on, and what other parasites or plant-lice will attack the green bug. In general, we may say that the present state of the work would indicate the parasite *Lysiphlebus tritici* Ashmead, to be, under proper conditions of temperature, a most effective check on the green bug; that it can survive lower temperature than the green bug; that it can use several common species of plant-lice as hosts, and is therefore unlikely to be totally absent from any locality in this state where the green bugs are present in damaging numbers; that the destruction of volunteer wheat and oats, thus depriving the green bug of some of its common summer food plants, would help to prevent it from infesting the regular crop, and that plowing under spots of seriously infested wheat is effective in preventing further spread from those spots. Further work must be done on this insect before a final solution of the problem can be reached.

Corn-ear Worm.—For reasons stated earlier in this report it seemed necessary to take up a study of the corn-ear worm. Such a study was begun this spring and carried forward in the hope of finding some practicable means of combating it. The work is well under way.

Mound-building Prairie Ant.—Investigations of this insect that had been carried forward for several years were completed

late last fall, and the results were embodied in Station Bulletin No. 154.

Gopher.—The study of the gopher's life-history, habits and methods of combating had reached a point last fall where it seemed desirable to publish, and accordingly the results up to that time were embodied in Bulletin No. 152 of this Station. We have planned to continue the study of the gopher's method of spreading from field to field, its winter storage of food, and further measures of controlling its ravages. Under the last head we are (1) attempting to devise a better bait than soaked corn to be used with our poisoned syrup; (2) testing the efficiency of certain widely advertised patent substances for destroying pocket gophers; (3) testing the value of certain promising traps.

Mole.—So much complaint of the destruction of seeds in the ground, particularly of corn, and of damage to gardens and lawns attributed to the work of the common garden mole has reached this office, that we have planned a careful study of its life-history and habits, and methods of combating.

Very truly yours,

T.J. HEADLEE.

REPORT OF THE HORTICULTURIST.

Prof. C. W. Burkett, director: In the fight against insects and fungi, continued through the present year, the application of the lime-sulfur wash as a preventive of scale has given results that strongly indicate a high fungicidal value. Its efficacy as an insecticide is well known, and further evidence of its value was secured when, in May, 1908, peach trees treated in March were practically free from the peach-louse, while untreated trees were badly infested. The foliage of the sprayed trees was practically free from leaf-curl, whereas untreated trees showed a considerable part of the leaves affected. The greatest value was in the evident prevention of brown rot, which caused serious loss on unsprayed trees, while the loss on sprayed trees was trifling. Late varieties suffered a heavier loss from rot than earlier ones, indicating the need of a later spray.

During and immediately after the period of bloom, some work in protecting peach trees from frost was attempted. The tests indicate that when the velocity of the wind is below seven

to eight miles an hour that pots of crude oil, placed at the rate of 100 per acre, will afford protection down to twenty-two degrees or ten degrees of frost. One gallon of crude oil, burned in an open pot, lasted nearly four hours. In the observations made concerning frost injury, the value of good air drainage is apparent. The east three rows of the vineyard are just west of a growth of pine trees and at the foot of a slope. Extending westward some twenty yards, these rows were seriously injured, while the rows higher up the slope were not seriously injured, the upper part of the slope producing a fair crop of fruit.

The same conditions were presented in the apple orchard. In the east part of the orchard all varieties were injured, while a fair crop was produced in the west half. The conditions were alike except as to air drainage, and enough varieties were represented to make the observation valuable to those selecting sites for orchards.

Strawberries were protected by drawing the mulching, previously between the rows, over the plants.

Although gooseberries were considerably damaged by frost while in blossom, all varieties bore light crops. In point of yield, the varieties ranked as follows : Carrie, Pearl, Downing, Columbus, Red Jacket, Smith's Improved, Triumph and Industry.

The persimmons maintain their previous good record of no injury from frost, the set of fruit of the varieties comparing closely with that of former years.

In the plum orchard it is gratifying to note the continued success of the European varieties, Damson and Lombard, and that the Green Gage trees prove more productive as they increase in age. The high quality of these varieties entitles them to increased consideration. Green Gage has been more subject to loss from brown rot than Damson and Lombard.

Fertilizer tests on potatoes and vegetables continue to indicate that where thorough cultivation and liberal applications of barn-yard manure are given, special fertilizers are valuable with onions, celery and lettuce. Peas, beans, tomatoes, potatoes and sweet corn have not paid for special fertilizers.

The forest-tree nursery work has been continued, fair stands of most species being obtained. The two-year-stratifying of red cedar seed again produced an excellent stand of young

trees. Measurement of the rate of growth of forest-trees has been continued, and furnishes encouragement to tree planters, as the more valuable species, oaks, walnuts and conifers, increase in rate of growth as they increase in age.

Respectfully submitted. ALBERT DICKENS.

REPORT OF THE VETERINARIAN.

Prof. C. W. Burkett, Director: I herewith submit report of work done by this department during the fiscal year ending June 30, 1908.

The efforts of the department for the last twelve months have been confined to a continuation of the study of the cause of so-called "blind staggers" (cerebritis) in horses. Some of the molds affecting the corn ear, husk and stalk have been investigated: First, their laboratory characteristics; second, their actions upon guinea-pigs, rabbits and the horse.

The treatment of contagious abortion in cattle has also been given considerable attention.

Respectfully submitted. F. S. SCHOENLEBER.